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TRANSACTIONS

AND

PROCEEDINGS

OF THE

Royal Society of New Zealand, Wellington

NEW ZEALAND INSTITUTE

1882

VOL. XV.

EDITED AND PUBLISHED UNDER THE AUTHORITY OF THE BOARD OF GOVERNORS OF THE INSTITUTE

BY

JAMES HECTOR, C.M.G., M.D., F.R.S.

B. 125

ISSUED MAY, 1883

WELLINGTON
LYON & BLAIR, PRINTERS, LAMBTON QUAY.
TRUBNER & CO., 60, PATERNOSTER ROW, LONDON.

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ADDENDA ET CORRIGENDA.

PAGE

70, line 20, *for* propodos *read* dactylos
73, line 8 from bottom, *for* Philongria *read* Philougria
77, line 12, *for* pleon *read* pereion
79, line 6, *for* ? Montaguana *read* ? Montagua
93, line 11 from bottom, *for* fuscate *read* furcate
140, line 15, *for* mangei *read* maugei
148, line 11 from bottom, *for* small *read* same
149, line 8 „ and elsewhere, *for* Philongria *read* Philougria
162, line 14 „ *for* Lezdig *read* Leydig
166, line 7 „ *after* part *dele* semicolon *and insert* a comma
175, line 1, *for* ascil *read* axil
175, line 4, *for* limbs *read* lines
175, line 7 from bottom, *dele* Theraphosides
176, line 9, *for* ascils *read* axils
177, line 6, *for* clumps *read* culms
177, line 11, *for* Thomisides *read* Salticus
188 and 190, in title, *for* 6th April *read* 30th November
194, line 13, *for* interior *read* exterior
198, line 12 from bottom, *for* ansonii *read* ausonii
200, line 6 „ *for* Saprolignia *read* Saprolegnia
209, line 4 „ *for* here *read* where
221, line 5, *for* vasculan *read* vascular
221, line 18 from bottom, *for* nitrata *read* nitrate
221, line 8 „ *for* this *read* their
224, line 19, *after* being *insert* eleven
226, line 2 from bottom, *after* loc. cit., p. *insert* 58 and 60
227, line 11 „ *for* epidymis *read* epididymis
228, line 7, *for* cœlum *read* cœlome
228, line 21, *for* on *read* as
228, line 7 from bottom, *for* cerebellan *read* cerebellar
230, line 3, *for* like *read* between
231, line 4, *for* Mechelian *read* Meckelian
233, line 3, *for* as *read* in
235, line 4 from bottom, *for* the *read* two
235, line 3 „ *for* this *read* their
273, line 6, *before* plants *insert* naturalized
277, line 8 from bottom, *for* larva *read* lava
282, line 19, *for* E. and L. *read* E. and Z.
283, line 18, *for* eeptophyllum *read* leptophyllum
283, line 24, *for* Larum *read* Carum
284, line 18, *for* Pakari *read* Pakiri

PAGE

284, line 3 from bottom, *for* Huask. *read* Haask.

286, line 6, *for* Cincus *read* Cnicus

287, line 25, *for* Polemoinaceæ *read* Polemoniaceæ

289, line 2 from bottom, *for* acinus *read* acinos

298, line 3, *for* Iatropha *read* Jatropha

302, line 17, *for* Montague *read* Montagne

303, line 18, *for* iridis *read* viridis

303, line 4 from bottom, *for* Fragillaria *read* Fragilaria

303, line 2 ,, *for* pectinale *read* pectorale

306, line 13 ,, *for* 2-4 feet *read* 2 feet 4 inches

318, line 20, *for* axils *read* arils

319, line 3, *for* H.B.K. *read* Handbook

333, line 9, *for* ring *read* rind

341, line 15 from bottom, *for* Triceratrum *read* Triceratium

342, line 5 ,, *for* Eucyonema *read* Encyonema

343, line 4 ,, *for* Eucyonema *read* Encyonema

343, line 14, *for* elliptrica *read* elliptica

372, under "Hydro-carbon," line 2, *for* 35·22 *read* 35·42

380, line 7, *for* four-sides *read* four-sided

384, line 13 from bottom, *for* Tohatapu *read* Tokatapu

387, line 7, *for* Tamata *read* Tomatea

387, line 19, *for* tetrahedral *read* tetartohedral

397, line 12, *for* down *read* from

403, line 22, *for* Si^3 *read* $\ddot{S}i^3$

406, line 5 from bottom, *for* Purahanui *read* Purakanui

408, line 13, *for* $\ddot{Z}r$, $\ddot{S}i$ *read* $\ddot{Z}r$ $\dot{S}i$

409, line 13 from bottom, *for* silicate *read* silicates

411, line 10 from bottom, *for* Siphonaria *read* Siphonalia

425, line 12, *for* boy. All *read* boy, all

430, line 2, *for* Rahigihoua *read* Rangihoua

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NEW ZEALAND INSTITUTE.

ESTABLISHED UNDER AN ACT OF THE GENERAL ASSEMBLY OF NEW ZEALAND INTITULED "THE NEW ZEALAND INSTITUTE ACT, 1867."

Board of Governors.

(EX OFFICIO.)

His Excellency the Governor. | The Hon. the Colonial Secretary.

(NOMINATED.)

The Hon. W. B. D. Mantell, F.G.S., W. T. L. Travers, F.L.S., James Hector, C.M.G., M.D., F.R.S., the Ven. Archdeacon Stock, B.A., Thomas Mason, M.H.R., the Hon. G. Randall Johnson, M.L.C.

(ELECTED.)

1882.—Mr. Justice Gillies, the Hon. William Rolleston, M.H.R., James McKerrow.

1883.—The Hon. William Rolleston, M.H.R., James McKerrow, Martin Chapman.

Manager:

James Hector.

Honorary Treasurer:

The Ven. Archdeacon Stock.

Secretary:

R. B. Gore.

ABSTRACTS OF RULES AND STATUTES.

Gazetted in the "New Zealand Gazette," 9th March, 1868.

Section I.

Incorporation of Societies.

1. No Society shall be incorporated with the Institute under the provisions of "The New Zealand Institute Act, 1867," unless such Society shall consist of not less than twenty-five members, subscribing in the aggregate a sum of not less than fifty pounds sterling annually, for the promotion of art, science, or such other branch of knowledge for which it is associated, to be from time to time certified to the satisfaction of the Board of Governors of the Institute by the Chairman for the time being of the Society.

2. Any Society incorporated as aforesaid shall cease to be incorporated with the Institute in case the number of the members of the said Society shall at any time become less than twenty-five, or the amount of money annually subscribed by such members shall at any time be less than £50.

3. The bye-laws of every Society to be incorporated as aforesaid shall provide for the expenditure of not less than one-third of its annual revenue in or towards the formation or support of some local public Museum or Library; or otherwise shall provide for the contribution of not less than one-sixth of its said revenue towards the extension and maintenance of the Museum and Library of the New Zealand Institute.

4. Any Society incorporated as aforesaid which shall in any one year fail to expend the proportion of revenue affixed in manner provided by Rule 3 aforesaid shall from thenceforth cease to be incorporated with the Institute.

5. All papers read before any Society for the time being incorporated with the Institute, shall be deemed to be communications to the Institute, and may then be published as Proceedings or Transactions of the Institute, subject to the following regulations of the Board of the Institute regarding publications :—

Regulations regarding Publications.

(*a*.) The publications of the Institute shall consist of a current abstract of the proceedings of the Societies for the time being incorporated with the Institute, to be intituled, "Proceedings of the New Zealand Institute," and of transactions comprising papers read before the Incorporated Societies (subject, however, to selection as hereinafter mentioned), to be intituled, "Transactions of the New Zealand Institute."

(*b*.) The Institute shall have power to reject any papers read before any of the Incorporated Societies.

(*c*.) Papers so rejected will be returned to the Society before which they were read.

(*d*.) A proportional contribution may be required from each Society towards the cost of publishing the Proceedings and Transactions of the Institute.

(*e*.) Each Incorporated Society will be entitled to receive a *proportional* number of copies of the Proceedings and Transactions of the Institute, to be from time to time fixed by the Board of Governors.

(*f*.) Extra copies will be issued to any of the members of Incorporated Societies at the cost price of publication.

6. All property accumulated by or with funds derived from Incorporated Societies and placed in the charge of the Institute, shall be vested in the Institute, and be used and applied at the discretion of the Board of Governors for public advantage, in like manner with any other of the property of the Institute.

7. Subject to "The New Zealand Institute Act, 1867," and to the foregoing rules, all Societies incorporated with the Institute shall be entitled to retain or alter their own form of constitution and the bye-laws for their own management, and shall conduct their own affairs.

8. Upon application signed by the Chairman and countersigned by the Secretary of any Society, accompanied by the certificate required under Rule No. 1, a certificate of incorporation will be granted under the Seal of the Institute, and will remain in force as long as the foregoing rules of the Institute are complied with by the Society.

Section II.

For the Management of the Property of the Institute.

9. All donations by Societies, Public Departments, or Private Individuals, to the Museum of the Institute, shall be acknowledged by a printed form of receipt, and shall be duly entered in the books of the Institute provided for that purpose, and shall then be dealt with as the Board of Governors may direct.

10. Deposits of articles for the Museum may be accepted by the Institute, subject to a fortnight's notice of removal to be given either by the owner of the articles or by the Manager of the Institute, and such deposits shall be duly entered in a separate catalogue.

11. Books relating to Natural Science may be deposited in the Library of the Institute, subject to the following conditions:—

(*a*.) Such books are not to be withdrawn by the owner under six months' notice, if such notice shall be required by the Board of Governors.

(*b*.) Any funds specially expended on binding and preserving such deposited books, at the request of the depositor, shall be charged against the books, and must be refunded to the Institute before their withdrawal, always subject to special arrangements made with the Board of Governors at the time of deposit.

(*c*.) No books deposited in the Library of the Institute shall be removed for temporary use except on the written authority or receipt of the owner, and then only for a period not exceeding seven days at any one time.

12. All books in the Library of the Institute shall be duly entered in a catalogue which shall be accessible to the public.

13. The public shall be admitted to the use of the Museum and Library, subject to bye-laws to be framed by the Board.

Section III.

14. The Laboratory shall, for the time being, be and remain under the exclusive management of the Manager of the Institute.

Section IV.

Of Date 23rd September, 1870.

Honorary Members.

Whereas the rules of the Societies incorporated under the New Zealand Institute Act provide for the election of Honorary Members of such Societies; but inasmuch as such Honorary Members would not thereby become members of the New Zealand Institute, and whereas it is expedient to make provision for the election of Honorary Members of the New Zealand Institute, it is hereby declared—

1st. Each Incorporated Society may, in the month of November next, nominate for election as Honorary Members of the New Zealand Institute three persons, and in the month of November in each succeeding year one person, not residing in the colony.

2nd. The names, descriptions, and addresses of persons so nominated, together with the grounds on which their election as Honorary Members is recommended, shall be forthwith forwarded to the Manager of the New Zealand Institute, and shall by him be submitted to the Governors at the next succeeding meeting.

3rd. From the persons so nominated, the Governors may select in the first year not more than nine, and in each succeeding year not more than three, who shall from thenceforth be Honorary Members of the New Zealand Institute, provided that the total number of Honorary members shall not exceed thirty.

LIST OF INCORPORATED SOCIETIES.

NAME OF SOCIETY.	DATE OF INCORPORATION.	
WELLINGTON PHILOSOPHICAL SOCIETY - - -	10th June,	1868.
AUCKLAND INSTITUTE - - - - - - -	10th June,	1868.
PHILOSOPHICAL INSTITUTE OF CANTERBURY - -	22nd October,	1868.
OTAGO INSTITUTE - - - - - - - -	18th October,	1869.
WESTLAND INSTITUTE - - - - - - -	21st December,	1874.
HAWKE'S BAY PHILOSOPHICAL INSTITUTE - - -	31st March,	1875.
SOUTHLAND INSTITUTE - - - - - - -	21st July,	1880.

WELLINGTON PHILOSOPHICAL SOCIETY.

OFFICE-BEARERS FOR 1882 :—*President*—W. T. L. Travers, F.L.S.; *Vice-presidents*—Hon. G. R. Johnson, Dr. Buller, C.M.G., F.R.S.; *Council*—A. K. Newman, M.B., M.R.C.P., J. P. Maxwell, A.I.C.E., R. Govett, M. Chapman, James Hector, M.D., C.M.G., F.R.S., S. H. Cox, F.G.S., F.C.S., T. King; *Auditor*—Oliver Wakefield; *Secretary and Treasurer*—R. B. Gore.

OFFICE-BEARERS FOR 1883 :—*President*—The Hon. G. Randall Johnson, M.L.C.; *Vice-presidents*—Dr. Buller, C.M.G., F.R.S., A. K. Newman, M.B., M.R.C.P.; *Council*—R. Govett, M. Chapman, James Hector, M.D., C.M.G., F.R.S., S. H. Cox, F.G.S., F.C.S., T. King, W. T. L. Travers, F.L.S., F. B. Hutchinson, M.R.C.S.; *Auditor*—H. F. Logan; *Secretary and Treasurer*—R. B. Gore.

Extracts from the Rules of the Wellington Philosophical Society.

5. Every member shall contribute annually to the funds of the Society the sum of one guinea.

6. The annual contribution shall be due on the first day of January in each year.

7. The sum of ten pounds may be paid at any time as a composition for life of the ordinary annual payment.

14. The time and place of the General Meetings of members of the Society shall be fixed by the Council and duly announced by the Secretary.

AUCKLAND INSTITUTE.

OFFICE-BEARERS FOR 1882 :—*President*—E. A. Mackechnie; *Council*—G. Aickin, J. M. Clark, Rt. Rev. W. G. Cowie, D.D., His Honour Mr. Justice Gillies, Hon. Colonel Haultain, Neil Heath, J. Martin, F.G.S., T. Peacock, J. A. Pond, Rev. A. G. Purchas, M.R.C.S.E., S. Percy Smith, F.R.G.S.; *Auditor*—T. Macffarlane; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S.

Office-bearers for 1883;—*President*—Rt. Rev. W. G. Cowie, D.D.; *Vice-presidents*—E. Mackechnie, T. Peacock, M.H.R.; *Council*—G. Aickin, J. L. Campbell, M.D., W. D. Campbell, F.G.S., Mr. Justice Gillies, Hon. Colonel Haultain, Neil Heath, J. Martin, F.G.S., J. A. Pond, Rev. A. G. Purchas, M.R.C.S.E., H. G. Seth Smith, S. Percy Smith, F.R.G.S.; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S.; *Auditor*—T. Macffarlane.

Extracts from the Rules of the Auckland Institute.

1. Any person desiring to become a member of the Institute, shall be proposed in writing by two members, and shall be ballotted for at the next meeting of the Council.

4. New members on election to pay one guinea entrance fee, in addition to the annual subscription of one guinea, the annual subscriptions being payable in advance on the first day of April for the then current year.

5. Members may at any time become life-members by one payment of ten pounds ten shillings, in lieu of future annual subscriptions.

10. Annual General Meeting of the Society on the third Monday of February in each year. Ordinary Business Meetings are called by the Council from time to time.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

Office-bearers for 1882:—*President*—Professor J. von Haast, F.R.S.; *Vice-presidents*—R. W. Fereday, Professor F. W. Hutton; *Hon. Secretary*—G. Gray; *Hon. Treasurer*—W. M. Maskell; *Council*—E. Dobson, J. Inglis, Professor A. W. Bickerton, T. Crook, T. S. Lambert, H. R. Webb; *Auditors*—C. R. Blakiston, W. D. Carruthers.

Office-bearers for 1883:—*President*—Professor F. W. Hutton; *Vice-presidents*—R. W. Fereday, E. Dobson; *Treasurer*, W. M. Maskell; *Secretary*—Geo. Gray; *Council*—Professor J. von Haast, Dr. Symes, C. Chilton, T. Crook, J. Inglis, T. S. Lambert.

Extracts from the Rules of the Philosophical Institute of Canterbury.

21. The Ordinary Meetings of the Institute shall be held on the first Thursday of each month during the months from March to November inclusive.

35. Members of the Institute shall pay one guinea annually as a subscription to the funds of the Institute. The subscription shall be due on the first of November in every year. Any member whose subscription shall be twelve months in arrears, shall cease to be a member of the Institute, but he may be restored by the Council if it sees fit.

37. Members may compound for all annual subscriptions of the current and future years by paying ten guineas.

OTAGO INSTITUTE.

Office-bearers for 1882:—*President*—W. Arthur, C.E.; *Vice-presidents*—G. M. Thomson, F.L.S., G. Joachim; *Hon. Secretary*—Professor Parker; *Hon. Treasurer*—D. Petrie, M.A.; *Auditor*—D. Brent, M.A.; *Council*—Right Rev. Bishop Nevill, Rev. Dr. Roseby, Professor Mainwaring Brown, Professor Scott, W. N. Blair, C.E., A. Montgomery, R. Gillies, F.L.S.

Office-bearers for 1883:—*President*—A. Montgomery; *Vice-presidents*—W. Arthur, C.E., Rev. Dr. Roseby; *Hon. Secretary*—Professor Parker; *Hon. Treasurer*—D. Petrie, M.A.; *Auditor*—D. Brent; *Council*—Dr. Hocken, Professor Scott, G. M. Thomson, F. Chapman, R. Gillies, G. Joachim, Professor Mainwaring Brown.

Extracts from the Constitution and Rules of the Otago Institute.

2. Any person desiring to join the Society may be elected by ballot, on being proposed in writing at any meeting of the Council or Society by two members, on payment of the annual subscription of one guinea for the year then current.

5. Members may at any time become life-members by one payment of ten pounds and ten shillings in lieu of future annual subscriptions.

8. An Annual General Meeting of the members of the Society shall be held in January in each year, at which meeting not less than ten members must be present, otherwise the meeting shall be adjourned by the members present from time to time, until the requisite number of members is present.

(5.) The session of the Otago Institute shall be during the winter months, from May to October, both inclusive.

WESTLAND INSTITUTE.

Office-bearers for 1883:—*President*—W. A. Spence; *Vice-president*—T. O. W. Croft; *Hon. Treasurer*—J. P. Will; *Secretary*—Richard Hilldrup.

Extracts from the Rules of the Westland Institute.

3. The Institute shall consist:—(1) Of life-members, *i.e.*, persons who have at any one time made a donation to the Institute of ten pounds ten shillings or upwards; or persons who, in reward of special services rendered to the Institute, have been unanimously elected as such by the Committee or at the general half-yearly meeting. (2) Of members who pay two pounds two shillings each year. (3) Of members paying smaller sums, not less than ten shillings.

5. The Institute shall hold a half-yearly meeting on the third Monday in the months of December and June.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

Office-bearers for 1882:—*President*—The Right Rev. the Bishop of Waiapu; *Vice-president*—Dr. Spencer; *Hon. Secretary and Treasurer*—Mr. Colenso; *Council*—Messrs. H. Baker, H. R. Holder, J. G. Kinross, F. J. de Lisle, F. W. C. Sturm, C. H. Weber; *Auditor*—T. K. Newton.

Office-bearers for 1883:—*President*—The Right Rev. the Bishop of Waiapu; *Vice-president*—W. I. Spencer (Mayor); *Hon. Secretary and Treasurer*—W. Colenso; *Council*—T. W. Balfour, J. N. Bowerman, H. R. Holder, T. K. Newton, F. W. C. Sturm, C. H. Weber; *Auditor*—T. K. Newton.

Extracts from the Rules of the Hawke's Bay Philosophical Institute.

3. The annual subscription for each member shall be one guinea, payable in advance, on the first day of January in every year.

4. Members may at any time become life-members by one payment of ten pounds ten shillings in lieu of future annual subscriptions.

(4.) The session of the Hawke's Bay Philosophical Institute shall be during the winter months from May to October, both inclusive; and general meetings shall be held on the second Monday in each of those six months, at 8 p.m.

SOUTHLAND INSTITUTE.

Office-bearers for 1882 :—*President*—J. T. Thomson, F.R.G.S.; *Vice-president*—W. S. Hamilton; *Hon. Treasurer*—J. C. Thomson; *Hon. Secretary*—P. Goyen; *Council*—Dr. Galbraith, T. Denniston, W. B. Scandrett, — Robertson, W. G. Mchaffey.

Office-bearers for 1883 :—*President*—J. T. Thomson, C.E., F.R.G.S.; *Vice-president*—Rev. P. W. Fairclough; *Secretary and Treasurer*—J. C. Thomson; *Council*—Dr. Galbraith, Messrs. Carswell, Denniston, Hamilton, Robertson, and Scandrett.

TRANSACTIONS

TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE

1882.

I.—ZOOLOGY.

Art. I.—*Descriptions of New Zealand* Micro-Lepidoptera.

By E. Meyrick, B.A.

[*Read before the Philosophical Institute of Canterbury, 4th May*, 1882.]

The present paper is the first of a series, which I hope to publish from time to time, describing the whole of the *Micro-Lepidoptera* of New Zealand; including under that term the *Pyralidina*, *Pterophorina*, *Tortricina* and *Tineina*. My intention is to take a family at a time, and monograph it as completely as is at present possible, prefacing each with some general remarks on its classsification and affinities, and the inferences which may be drawn from its distribution with relation to New Zealand. For the sake of convenience and expedition, I shall not take the families in their natural order, but according as for various reasons they are easiest treated.

The most essential character for classification is the neuration, and it is absolutely necessary that this should be investigated for the accurate determination of genera. It is not, however, by any means always necessary that a specimen should be denuded of scales for the purpose; with the aid of a lens the veins can generally be made out by inspection of the undersurface of the wing, where they are more prominent, especially if one has previously examined types of the principal groups and learnt what to look for. The terminology employed hereafter is that generally in use on the Continent of Europe, and from its simplicity and adaptability is far superior to the awkward and confusing nomenclature sometimes adopted. The veins are all numbered, starting from the one nearest the inner margin, and ending with the one nearest the costa. Typically, there are in the forewings twelve veins, 1 and 12 being free, and the other ten springing from the margins of a central cell, consisting of an upper, lower and hind-margin, often called the sub-costal, median (or upper and lower median), and transverse veins; sometimes there is a partition-vein in the upper part

of the cell, forming a secondary cell ; there are, also, two free false veins, often obsolete, one on each side of vein 1, known as 1*a* and 1*b*. The structure of the hindwings is the same, except that there are only six veins rising from the cell, or eight altogether. Any two veins may coincide partially, when they appear to rise from a common stalk ; or wholly, when their number appears diminished. In the lowest groups of the *Tineina* the venation is commonly very incomplete, without any distinct cell. The other points of structure to be especially noted are the form of the labial palpi, the absence or development of the maxillary palpi, the antennæ, the scaling of the head (in the *Tineina*), and some minor details. The legs and abdomen very rarely afford any characters worthy of notice. It must, also, be especially borne in mind that the form of the wings is in general almost valueless for generic distinction and should never be relied on ; but exception may be made in the hindwings of some of the *Tineina*, which from their great diversity often furnish serviceable points of distinction. The measurements in the following descriptions are given in millimetres (for practical purposes, 25 = 1 inch), which have the advantage of being comprehensible without confusion in all countries, and are now very commonly adopted.

Little need be said of what has been hitherto done in the investigation of the *Micro-Lepidoptera* of New Zealand. Doubleday and Zeller have incidentally described a very few, only about a dozen altogether ; their descriptions are excellent and all easily recognizable. I am indebted to Prof. Zeller for sending me his original figures of the New Zealand species of *Crambus* described by him, to ensure their accurate determination. Felder has figured a small number of species, but as his figures are commonly poor and hard to identify, and his classification wholly conjectural, it would have been better if he had left them alone. Walker, in his British Museum Catalogue, has described a good many ; but his work, as I have elsewhere sufficiently pointed out, is useless for scientific purposes. His descriptions are strictly, almost always quite, unidentifiable ; but I have adopted his specific names from a comparison of the types, when it appeared that the specimens standing as types are really those intended by the description, and when the types are, also, themselves recognizable, which is by no means always the case. But as genera are not realities but abstractions, I have conceived it to be impossible to adopt his generic titles, unless the characters given really indicate the distinctive points of the genus, which hardly ever happens. Latterly Mr. A. G. Butler, of the British Museum, has turned his attention to these groups, but, I grieve to say, with most unsatisfactory results. For example, as I have pointed out hereafter, he has described three typical species of

Crambus and referred them separately to the *Galleridæ*, *Phycidæ*, and *Chilonidæ*, three groups which do not even, so far as is known, occur in New Zealand at all. In the same paper he has described the sexes of one of the *Tortricina* as two distinct species, and placed them in two distinct genera in different families, when in fact the species was not in the least allied to either of those genera, and the sexes, though slightly differing in appearance, are precisely identical in structure. I could multiply instances, but they will be referred to in their proper place, and I desire now only to point out clearly that Mr. Butler's authority on these groups is as unreliable as that of Walker.

The *Crambidæ*, which form the subject of the present paper, are represented in New Zealand, so far as is at present known, by 29 species, of which 16 are here described for the first time. The character of this fauna is very interesting. Seventeen species, or more than half, belong to the genus *Crambus;* this cosmopolitan genus is nearly equally plentiful throughout the world, but it is very remarkable that it is almost entirely absent from Australia, whence are known only two species, of which certainly one, and perhaps both, do not belong to the indigenous fauna, and neither is related to the New Zealand species. These latter form a single connected group, diverging from a common centre, which appears to be *C. vittellus*, the commonest and most variable species of the group, and very similar to some European forms. From the unity of the group, and its connection with the rest of the genus at one point only, it is natural to infer its common origin; but it seems hardly probable that this origin should have been by way of Australia, or representatives would have been found there, as they are universally elsewhere. Nine species belong to the peculiar and very distinct genus *Diptychophora;* besides these there are as yet only four other species of the genus known, three being from South America, and the fourth from Australia. The South American species are nearly allied to most of those inhabiting New Zealand, so that we have here another very clear illustration of the affinity between the fauna of South America and that of New Zealand, which is indicated in several other groups of animals and plants. Not much stress can be laid on the single Australian species, though it is of a rather peculiar type, differing markedly from any other. The remaining three species of the family are referable to three different genera, one of these being *Thinasotia*, very largely represented in Australia; the New Zealand species is very distinct, yet perceptibly allied to a Tasmanian species. The other two genera are endemic, and apparently form transitional links between *Thinasotia* and *Diptychophora*, so that they may perhaps be regarded as approaching in character the common progenitors of these two very distinct genera. In connection with the above may be noticed the entire absence of the large nearly-allied family of the *Phycidæ*, which occur

in tolerable plenty throughout the whole world, the Australian species being numerous and in the main very similar to those found elsewhere. The *Galleridæ*, a small family of world-wide distribution, are also not found, and the cosmopolitan genera *Schœnobius*, *Scirpophaga*, *Chilo*, and *Prionopteryx*, are similarly remarkable by their absence.

The above remarks are not intended to express final conclusions, but only to call attention to inferences which seem fairly deducible from the facts known, as a means to the rational classification of the group.

I desire to acknowledge my great indebtedness in the preparation of these papers to Mr. Fereday, whose very valuable and extensive collection has been freely placed at my disposal in the interests of science; without his assistance it would have been impossible for me to have treated the subject with any degree of completeness.

CRAMBIDÆ.

Labial palpi porrected, generally long. Maxillary palpi triangular, porrected, conspicuous. Forewings with 12 veins (rarely fewer, but not in New Zealand genera), vein 1 simple, 8 and 9 stalked, 7 sometimes from same stalk. Hindwings with 8 veins (rarely 7, but not in New Zealand genera), 4 and 5 often stalked, 7 and 8 stalked, lower median vein pectinated at base.

In the absence of the *Phycidæ*, this family is not likely to be confused with any other in New Zealand, except with the group of *Scoparia* and its allies; some of these latter approach nearly to *Crambus* in superficial appearance, but may be invariably recognised by the absence of the basal pecten, or fringe of hairs, on the upper surface of the lower median vein of the hindwings. Care must be taken to note the right vein, as the other veins often bear basal pectinations which are not of the same importance.

Five genera are represented in New Zealand, which may be thus distinguished:

A. vein 7 of forewings separate.
- I. vein 11 of forewings coalescing with 12 before costa .. .. 4. *Diptychophora.*
- II. ,, ,, ,, separate.
  - *a.* forewings with raised tufts of scales on surface .. .. 2. *Cryptomima.*
  - *b.* ,, smooth.
    - 1. female with abbreviated wings .. .. 3. *Scenoploca.*
    - 2. ,, fully developed .. .. 1. ~~*Thinasotia*~~. Hednota

B. ,, ,, ,, rising out of stalk of 8 and 9 .. .. 5. *Crambus.*

Hednota Meyr 1. ~~THINASOTIA, Hb.~~ (See vol XX p 69)

Antennæ of male finely ciliated. Labial palpi long, attenuated. Forewings with 12 veins, 8 and 9 stalked. Hindwings with 8 veins, 4 and 5 stalked or from a point, 6 widely remote at origin from 7, 7 and 8 stalked, cell closed.

This genus is largely represented in Australia, but very little elsewhere; I have only one New Zealand species. None of the larvæ are known, but from the habits of the imago there can be no doubt that they feed on grasses, probably amongst the roots. The imagos are commonly large and handsomely marked, but the New Zealand species is one of the dullest in colouring.

1. *Thin. leucophthalma*, n. sp.

Male, female.—19–23 mm. Head light greyish-ochreous, sometimes fuscous-tinged. Palpi light greyish-ochreous, strongly mixed with blackish-fuscous, labial palpi very long. Antennæ greyish-fuscous. Thorax light greyish-ochreous, more or less strongly mixed with blackish-fuscous. Abdomen whitish-ochreous, suffusedly irrorated with dark fuscous. Legs whitish-ochreous, irrorated with dark fuscous; anterior and middle tibiæ and tarsi suffused with blackish except at apex of joints, posterior tarsi dark fuscous towards base of joints. Forewings moderately broad, triangular, costa very slightly arched, somewhat bent before apex, apex obtusely pointed, hindmargin moderately oblique, rather strongly sinuate below apex; ochreous-whitish, when fresh slightly pinkish or purplish-tinged, thickly and coarsely irrorated with dark fuscous, towards inner margin slightly more ochreous-tinged, and towards disc more or less strongly suffused with light ochreous-fuscous; a small irregular black spot on inner margin almost at base, and a similar one below costa almost at base; an irregular sinuate longitudinal black streak, attenuated at extremities, extending almost from base along submedian fold to $\frac{1}{3}$ from base; an elongate-ovate black spot in disc rather above and beyond posterior extremity of the sinuate streak, anterior end rather acute; a rather ill-defined dark fuscous transverse line, preceded by a pale line, from costa at $\frac{2}{5}$ to middle of inner margin, most distinct on costal half, twice dentate beneath costa, bent round posterior extremity of the black spot, and again twice dentate above inner margin; a short suffused inwardly oblique dark fuscous mark on costa beyond middle; a sharply-defined obliquely transverse elongate white black-margined spot in disc at $\frac{3}{5}$, upper part slightly greyish-tinged; a double indistinctly dentate dark fuscous transverse line, enclosing a pale line, from about $\frac{4}{5}$ of costa to inner margin a little before anal angle, upper third rather inwardly oblique, lower two-thirds strongly outwards-curved, forming indistinct spots on costa and in middle: cilia ochreous-whitish, with two ill-defined dark grey lines. Hindwings whitish-fuscous-grey, with an indistinct darker band along hindmargin, not extending to anal angle, closely preceded by an indistinct suffused dark line; cilia ochreous-whitish, with a broad fuscous-grey line near base, and a much fainter one posteriorly.

Nearest to *T. impletella*, Walk., and *T. longipalpella*, Meyr., and somewhat intermediate between these two species, but not capable of confusion with them or any other; the black markings towards base are a sufficient distinction.

I have only met with this species in one place on the grassy volcanic hills near Christchurch, where it was sufficiently common in March.

2. Cryptomima, n. g.

Antennæ of male shortly ciliated. Labial palpi long, attenuated. Forewings broad, surface with tufts of raised scales; with 12 veins, 8 and 9 stalked. Hindwings with 8 veins, 4 and 5 stalked, 6 widely remote at origin from 7, 7 and 8 stalked, cell closed.

Nearly allied to *Thinasotia*, from which it can only be distinguished by the tufts of scales on the forewings, though in superficial appearance and habit very dissimilar; in these respects it approaches *Diptychophora*, but differs considerably in venation. The larva probably feeds on moss or lichens. The genus is probably confined to New Zealand; I have only one species.

1. *Crypt. acerella*, Walk.

(*Gadira acerella*, Walk., Brit. Mus. Cat. Suppl., 1742; *Botys mahanga*, Feld., Reise der Novara, Pl. CXXXVII., 27.)

Male, female.—17–18½ mm. Head light greyish-ochreous, mixed with white on crown, with a white stripe along anterior margin of eyes. Maxillary palpi pale greyish-ochreous, with a dark fuscous band, apex white. Labial palpi pale greyish-ochreous, mixed on side with dark fuscous, and above and internally with white. Antennæ pale greyish-ochreous. Thorax pale ochreous mixed with dark fuscous, and on back with white. Abdomen ochreous-whitish, suffused with ochreous-fuscous except at apex of segments. Legs dark ochreous-fuscous, middle and posterior tibiæ banded with ochreous-whitish, all tarsi with ochreous-whitish rings at apex of joints. Forewings broad, triangular, costa at first straight, slightly sinuate in middle, strongly arched towards apex, apex obtuse, hindmargin sinuate above and again below middle, moderately oblique; dull ochreous-fuscous, with scattered black scales; veins on basal half of wing marked by white lines; some whitish scales towards basal third of costa; a short suffused white streak along costa beyond middle; a very inwardly oblique white line from costa at ⅜ to submedian fold near base, obliterated on veins, only distinct at extremities; a straight double white line from middle of costa to before middle of inner margin; a blackish 8-shaped mark in disc beyond middle, upper half containing a spot of ground-colour, lower half a clear white spot; a ridge-like tuft of raised scales below middle of disc; a strongly outwards-curved double white line from ¾ of costa to ¾ of inner margin, inner edge

preceded by an obscure whitish suffusion; an irregular dentate suffused white mark at apex; an irregular white line along hindmargin, tending to form a spot in middle, and two confluent spots below middle; hind-marginal edge blackish: cilia greyish-ochreous, more whitish at anal angle, with two suffused darker fuscous lines, and with a white spot above apex. Hindwings whitish-fuscous-grey, with a dark grey spot before middle, a narrow irregular well-defined grey band close before hindmargin, and a sinuate grey line closely preceding band; an interrupted blackish-grey hind-marginal line; cilia grey-whitish, with a grey line near base.

Peculiar in facies, readily known by the two double white transverse lines.

Tolerably common at Christchurch on fences and old walls in January, and I have also taken it at light; occurs also at Dunedin. Mr. R. W. Fereday informs me that the imago has the same habits as *Dipt. elaina*, whence it is probable that the larva feeds in the same way.

3. SCENOPLOCA, n. g.

Antennæ of male crenulate, ciliated. Labial palpi moderately long, terminal joint slender, exposed, hairs of second joint produced beneath into an obliquely projecting tuft. Wings in female much abbreviated, incapable of flight. Forewings with 12 veins, 8 and 9 stalked. Hindwings with 8 veins, 4 and 5 from a point, 6 widely remote at origin from 7, 7 and 8 stalked, cell closed.

This genus is nearly allied in venation and other respects to the two preceding, but is distinguished from all by the abbreviated wings of the female; the palpi also afford a noticeable character, for the long projecting hairs of the second joint, instead of being appressed to the terminal joint, are sufficiently depressed to form a very distinct oblique tuft, but some species of *Thinasotia* show traces, though less marked, of a similar structure. The larva is of the normal type, and feeds on lichens. Only one species is as yet known to me.

1. *Scen. petraula*, n. sp.

Male.—16½–20 mm. Head grey-whitish, forehead blackish. Palpi blackish, apex of maxillary palpi, and of second and terminal joints of labial palpi, grey-whitish. Antennæ dark fuscous. Thorax grey-whitish, shoulders mixed with blackish, back wholly suffused with blackish. Abdomen ochreous-grey-whitish. Anterior and middle legs black, tarsi with a white ring at base of first three joints, middle tibiæ with a suffused whitish median band; posterior tibiæ grey towards base and at apex whitish, tarsi ochreous-white with a dark grey band on each joint. Forewings triangular, moderate or rather narrow, costa very slightly arched, somewhat more before apex, apex rounded, hindmargin regularly rounded, oblique; white,

more or less slightly greyish-tinged, closely but irregularly irrorated with blackish; a suffused curved blackish spot extending from inner margin near base to base of costa; an irregular oblique blackish patch in disc at $\frac{1}{3}$ from base, extending suffusedly to costa, and suffusedly connected beneath with a small blackish spot on inner margin at $\frac{1}{4}$, its posterior edge bordered by a pale oblique outwardly curved line from $\frac{1}{3}$ of costa to before middle of inner margin, shortly dentate at $\frac{1}{3}$ from costa, posteriorily margined by a blackish line, forming a small spot on costa and a rather larger one on inner margin; a small oblique transverse clear white spot in disc beyond middle, surrounded by a blackish suffusion, forming a black spot below middle, and a black spot on costa at $\frac{3}{5}$; an indistinct obscurely-dentate pale line, margined on each side indistinctly with blackish, from costa at $\frac{4}{5}$ to inner margin before anal angle, somewhat angulated inwards below costa, thence gently curved, anterior black line forming two small confluent black spots towards inner margin, posterior line forming a blackish wedge-shaped spot on costa: cilia ochreous-white, with a regularly-interrupted blackish-grey line towards base, and another towards extremities, costal cilia white, with a blackish-grey spot above last transverse line. Hindwings grey, rather darker posteriorily, with a faintly indicated pale line a little before hindmargin; cilia ochreous-grey-whitish, with two light grey lines.

Female.—$9\frac{1}{2}$–$11\frac{1}{2}$ mm. Forewings very narrow, oblong; hindwings proportionately shorter, rounded; markings as in male, but cramped and obscured.

Superficially the male of this species rather suggests a small dark *Thin. leucophthalma*, especially by the similarity of the white discal spot, but the black basal markings of the latter species afford a ready distinction.

I found this species plentifully, sitting on the face of the bare volcanic rock which projects in many places from the soil of the hills near Christchurch; it was reluctant to take wing, perhaps owing to the prevalence of high winds. The female, when disturbed, ran with considerable activity, but was quite incapable of flying.

Larva moderately stout, cylindrical, wrinkled, very sluggish; rather dark greyish-fuscous on back, much lighter on sides; spots minute, blackish, obscure; head fuscous. Feeds beneath a light shelter of silk on lichen-dust on rocks, living in a crevice, and issuing forth beneath its shelter to feed. I found the imago in fresh condition in March, and at the same time I discovered the larva in all stages, so that there is probably a succession of broods.

4. Diptychophora, Z.

Antennæ of male very finely ciliated. Labial palpi rather short, somewhat triangular. Forewings with hindmargin twice indented on upper half;

with 12 veins, 8 and 9 stalked, 11 coalescing with 12 before costa. Hindwings with 8 veins, 5 from above angle of cell, 6 moderately approximated to 7, 7 and 8 stalked, cell closed.

A very distinctly characterized genus, of the general type of *Thinasotia*, but with vein 11 of the forewings running into 12 before reaching costa, vein 5 of the hindwings rising from the transverse vein above the angle of cell, and the hindmargin of forewings twice indented above middle. The venation of all the New Zealand species is perfectly constant. Three species have been described from South America, and one from Australia; nine are here given, so that the genus apparently reaches its maximum of development in New Zealand. The species are all rather small insects, with broadly triangular forewings, generally rather elegantly marked, the markings consisting typically of two slender transverse lines, a white or metallic discal spot, and generally three black spots on lower part of hind margin. The larva feeds in moss. The imagos are often overlooked, and probably many more will be discovered.

The species here described may be thus distinguished :—

A. Discal spot obsolete .. .. 1. *pyrsophanes.*
B. „ „ distinct
  1. Discal spot black .. .. 9. *elaina.*
  2. „ „ wholly white
    a. Hindwings dark fuscous .. .. 8. *helioctypa.*
    b. „ grey or white
      i. Discal spot with three projecting teeth .. .. .. 3. *astrosema.*
      ii. „ „ „ one projecting tooth
        * Hindwings grey .. .. 4. *lepidella.*
        ** „ clear white .. .. 5. *leucoxantha.*
  3. Discal spot more or less leaden-metallic
    a. Hindwings white .. .. 6. *metallifera.*
    b. „ grey
      i. First transverse line strongly dentate above inner margin .. .. 2. *chrysochyta.*
      ii. „ „ „ regularly curved .. .. .. 7. *auriscriptella.*

1. *Dipt. pyrsophanes*, n. sp.

Male, female.—13½–16 mm. Head ochreous or brownish-ochreous. Palpi light yellowish-ochreous, externally more brownish. Antennæ dark fuscous. Thorax rather dark purplish-fuscous. Abdomen dark purplish-fuscous, with a light yellowish ring near base. Legs clear whitish-ochreous. Forewings triangular, very broad posteriorly, costa very gently arched, apex rounded, hindmargin oblique, indentations moderately deep; ochreous-brown, almost wholly suffused with dark purplish-fuscous except narrowly along hindmargin and more broadly at apex and anal angle, and finely irrorated with grey, especially towards costa and disc beyond middle; a

very small triangular yellow spot on inner margin at $\frac{1}{4}$; an equally small rather subquadrate yellow spot on inner margin at $\frac{3}{4}$, with a pale yellow dot rather above and beyond its apex; a very faintly perceptible darker transverse line from costa at $\frac{1}{4}$ to first dorsal spot, sharply angulated outwards beneath costa; a suffused darker spot in disc above and beyond middle; a small outwardly oblique triangular pale yellow spot on costa at $\frac{3}{4}$, sometimes closely preceded by a faint oblique yellowish costal mark; a very small suffused pale yellowish spot on costa before apex; a dark fuscous dot in apex, preceded by a clear white dot; sometimes a white dot on hindmargin in upper indentation; a slender dark fuscous hindmarginal line: cilia whitish ochreous, with a dark grey line near base, on indentations wholly clear white, a dark grey spot at apex, another between indentations, a third above anal angle, a fourth on anal angle. Hindwings fuscous-grey, with a very indistinct darker line posteriorly; a dark fuscous hindmarginal line; cilia grey-whitish, with a grey line near base.

Very distinct through the dark purplish-fuscous suffusion of the forewings, causing the discal spot to be obsolete, and throwing the yellow marginal spots into sharp relief; the spotted cilia also afford a good character.

Common at Wellington in January amongst scrub, and also at Lake Wakatipu; probably widely distributed.

2. *Dipt. chrysochyta*, n. sp.

Male.—11$\frac{1}{2}$–12 mm. Head and thorax pale ochreous. Palpi ochreous-yellow, with a dark fuscous spot at base and apical half dark fuscous, internally whitish-ochreous. Antennæ whitish-ochreous. Abdomen whitish-ochreous-grey. Legs pale whitish-ochreous. Forewings triangular, very broad posteriorily, costa very gently arched, apex rounded, hindmargin oblique, sinuations moderately deep; light yellowish-ochreous, apex and hindmargin narrowly suffused with brownish, in one specimen basal half wholly suffused irregularly with brownish; a well-defined double dark fuscous transverse line from costa near base to inner margin before middle, very strongly curved outwards, dentate inwardly a little above inner margin, enclosing a pale line becoming almost clear white on inner margin; an oblique dark fuscous mark on costa beyond middle, giving rise to an indistinctly dentate suffused brown transverse line to middle of inner margin, which it hardly reaches; this line bounds the brown suffusion in the darker specimen; on it, rather above middle, is a small transverse 8-shaped spot, upper half leaden-metallic, lower half clear white; a slender rather irregular dark fuscous transverse line from costa at $\frac{3}{5}$ to inner margin at $\frac{3}{4}$, upper two-thirds very strongly curved outwards, lower half nearly followed by a similar line, diverging a little on inner margin; this line is preceded and

followed on costa by a pale yellowish spot, and the space between it and the suffused median line is more distinctly yellow, especially below discal spot; an oblique pale yellowish mark on costa before apex, terminating in a rather metallic white dot; three slender longitudinal leaden-metallic streaks extending from discal spot to hindmargin, lowest one not reaching discal spot; a leaden metallic line within the second double tranverse line from below middle almost to inner margin; three small quadrate black spots on hindmargin near together below middle: cilia violet-metallic-grey, with a deeper basal line. Hindwings grey, with a dark fuscous hindmarginal line: cilia grey-whitish, with an indistinct darker line.

The smaller species of the genus; it is a rather brightly-marked insect, with considerable affinity to *D. auriscriptella*, but darker, and with the first line strongly dentate beneath.

Two specimens taken at Auckland amongst scrub in January.

interrupta Feld Vol XVII p130

3. *Dipt.* ~~*astroscma*, n. sp.~~

Male.—15–16 mm. Head white, ochreous-tinged behind. Palpi dark fuscous, internally and beneath white; apex of maxillary palpi white. Antennæ whitish-ochreous. Thorax light ochreous, with a few white scales. Abdomen and legs whitish. Forewings triangular, broad, costa almost straight, somewhat arched towards apex, apex rounded, hindmargin oblique, sinuations moderate; light rather bright ochreous-brown, mixed with darker in disc and towards apex; a small very suffused white spot beneath base of costa; a triangular snow-white blotch in disc towards base, its apex touching base of wing, its sides parallel to costa and inner margin, its base resting on first transverse line; first transverse line slender, dark fuscous, from costa at $\frac{1}{3}$ obliquely outwards to upper angle of white blotch, thence sharply bent inwards and continued to inner margin at $\frac{1}{3}$; a moderately large oblong snow-white dark-margined spot in disc beyond middle, parallel to hindmargin, its upper extremity sending a rather long sharp tooth towards costa and another towards hindmargin, its lower extremity sending a third towards anal angle; second transverse line from $\frac{4}{5}$ of costa to $\frac{4}{5}$ of inner margin, slender, almost obsolete, followed on costa by a suffused white triangular spot, beneath which is a small white suffusion on anterior side of line; a small white spot in apex, and a whitish suffusion in anal angle; four rather indistinct leaden-metallic longitudinal lines between discal spot and hindmargin; three small subquadrate black spots near together on hindmargin below middle: cilia shining white, with a blackish-grey line. Hindwings dull whitish, slightly greyish-tinged, with a dark grey hind-marginal line; cilia whitish, with an indistinct grey line near base.

Very distinct through the peculiar three-toothed discal spot and the white blotch towards base; allied to *D. lepidella* and *D. leucoxantha*, and in respect of the hindwings intermediate.

Three specimens taken by Mr. R. W. Fereday at Christchurch, Nelson, and Akaroa respectively, in January.

4. *Dipt. lepidella*, Walk.

(*Eromene lepidella*, Walk., Brit. Mus. Cat. Suppl. ; *Crambus gracilis*, Feld., Reise der Novara, Pl. CXXXVII., 26.)

Male, female.—$19\frac{1}{2}$–$20\frac{1}{2}$ mm. Head, antennæ and thorax pale ochreous. Palpi dark fuscous, at base white beneath. Abdomen whitish-grey-ochreous. Legs whitish-ochreous. Forewings triangular, broad, costa slightly arched, apex rounded, hindmargin oblique, sinuations moderate; pale yellowish-ochreous; costa somewhat suffused with brownish towards base; a very slender sometimes indistinct dark fuscous transverse line from costa at $\frac{1}{3}$ to inner margin before middle, costal third straight, outwardly oblique, thence irregular, rather strongly bent inwards a little above inner margin; a small longitudinally-placed semicircular silvery-white spot in disc beyond middle, its anterior angle shortly and narrowly produced upwards; a short linear dark fuscous mark along middle of costa; a very slender sometimes indistinct dark fuscous transverse line from costa at $\frac{4}{5}$ to inner margin at $\frac{4}{5}$, suddenly bent outwards beneath costa, thence moderately outwards-curved, lower third sinuate; sometimes a triangular brown patch on costa immediately beyond first transverse line, extending suffusedly to beneath discal spot; a small suffused brown spot on costa a little beyond second transverse line, sometimes giving rise to a brown suffusion extending to beneath discal spot where it meets the first suffusion, but both these are sometimes wholly obsolete; three short linear longitudinal leaden-metallic streaks crossing second transverse line above middle, and three very short similar streaks below middle; a dark fuscous hindmarginal line; three small roundish black spots close together on hindmargin below middle: cilia shining grey, with a dark metallic-grey basal line. Hindwings fuscous-grey, with an indistinct darker posterior line, and a dark fuscous hindmarginal line; cilia grey with a faint darker line.

Most allied to *D. leucoxantha*, which it resembles in the character of the discal spot, but is immediately known by the duller ground-colour and grey hindwings; in superficial colouring it is very similar to *D. auriscriptella*, but is considerably larger, and the discal spot is wholly different. The brownish suffusion in this species is very variable, as in *D. chrysochyta*.

I took four specimens at Dunedin at light in January; Mr. R. W. Fereday has met with it at Christchurch and Lake Wakatipu in the same month.

5. *Dipt. leucoxantha*, n. sp.

Female.—19 mm. Head and thorax light orange-ochreous. Palpi ochreous-orange, base, apex and upper surface mixed with dark fuscous. Antennæ whitish-ochreous. Abdomen ochreous-whitish, posteriorly suffused with grey. Legs whitish-ochreous. Forewings triangular, very broad posteriorly, costa very gently arched, apex rounded, hindmargin oblique, sinuations moderate; light ochreous-orange, becoming deeper orange posteriorly, especially towards apex; transverse lines obsolete, second faintly perceptible, slightly darker, sinuate and outwards-curved, from about $\frac{3}{4}$ of costa to $\frac{4}{5}$ of inner margin; a comparatively rather large oval snow-white spot in disc beyond middle, suffusedly margined with dark fuscous, anterior extremity produced upwards into a blunt tooth; a transverse series of eight very short slender longitudinal leaden-metallic streaks on second line, second and third from costa considerably longer than the rest: cilia ochreous-white, with a dark grey spot at apex and another at anal angle, and a deep grey brassy-metallic basal line. Hindwings white, towards hindmargin faintly yellowish-tinged; cilia white.

A very beautiful and distinct species, resembling *D. lepidella* in the character of the discal spot, but differing from all in the orange forewings; the clear white hindwings, and absence of the black hindmarginal spots are also reliable points; the obsolescence of the transverse lines is perhaps not constant.

One perfect specimen taken by Mr. R. W. Fereday near Lake Wakatipu in January.

6. *Dipt. metallifera*, Butl.

(*Eromene metallifera*, Butl., Proc. Zool. Soc., Lond., 1877, 401, Pl. XLIII., 11.)

"19 mm. Allied to *D. auriscriptella*, but forewings rather brighter in colour, the transverse lines only half as wide apart, the silver discal spot less curved and edged with brown; a series of longitudinal discal silver lines between the veins; hindwings white."

I saw Butler's type in the British Museum and noted it as a distinct species, but have been unable to obtain a specimen for description. The above is the only description that Butler gives, (I have taken the liberty of altering his terminology), and I consider it hardly accurate. The transverse lines are represented in the figure as in their usual position, and it may be conjectured that Butler has mistaken a central suffused line, which is also represented on dorsal half, for one of the usual two transverse

lines; the discal spot is edged with brown in *D. auriscriptella* also, and is not curved at all in that species, though the posterior edge is concave, and the anterior as well; the series of longitudinal metallic lines is also present in *D. auriscriptella;* and I believe the size given is too large. However, the white hindwings and the almost wholly leaden-metallic discal spot constitute in themselves a sufficient distinction.

The specimen is stated to be from Dr. Hector's collection; which I understand to have been mainly taken by Mr. J. D. Enys in the neighbourhood of Mount Hutt.

7. *Dipt. auriscriptella*, Walk.

(*Eromene auriscriptella*, Walk., Brit. Mus. Cat., 976.)

Male, female.—14–15 mm. Head and thorax light yellowish-ochreous. Palpi rather long, ochreous-orange, base and apical third dark fuscous. Antennæ whitish-ochreous. Abdomen pale ochreous-grey. Legs ochreous-grey-whitish. Forewings triangular, very broad posteriorly, costa gently arched, apex rounded, hindmargin oblique, second sinuation slight; pale yellowish-ochreous, deeper ochreous on disc, and towards apex and hind margin; costa dark fuscous towards base; a slender double dark fuscous transverse line from costa at $\frac{1}{3}$ to middle of inner margin, strongly and regularly curved outwards, inner line obsolete on upper half, diverging somewhat on inner margin, enclosing on lower two-thirds a leaden-metallic line, becoming shining whitish on inner margin; a very small dark fuscous spot on middle of costa; a small elongate transverse spot in disc beyond middle, narrowed in middle, upper half leaden-metallic, lower half white; a slender double dark fuscous transverse line from costa at $\frac{3}{4}$ to inner margin a little before anal angle, rather obsolete on disc, upper two-thirds strongly outward-curved, lower third sinuate, included space indistinctly shining whitish; two longitudinal leaden-metallic streaks between discal spot and hindmargin, nearly reaching both, a much shorter streak below them, and rest of second transverse line spotted with leaden-metallic on intersection of veins; a leaden-metallic dot in apex; three small subquadrate black spots near together on hindmargin below middle: cilia rather dark grey, with a deep grey brassy-metallic basal line. Hindwings grey, with a dark grey hind-marginal line; cilia grey.

Distinguishable from all but *D. chrysochyta* by the discal spot, which has the upper half leaden-metallic and the lower white; it is a duller and paler insect than *D. chrysochyta*, without indentation on the first transverse line. *Crambus gracilis*, Feld., is not a synonym of this species, as stated by Butler, but of *D. lepidella.*

Several specimens taken at Wellington and Port Lyttelton in January amongst scrub.

8. *Dipt. helioctypa*, n. sp.

Male, female.—14–15 mm. Head, palpi, and thorax rather dark greyish-fuscous mixed with whitish-ochreous, palpi white at base beneath. Antennæ dark fuscous. Abdomen fuscous-grey, irrorated with ochreous towards base, apex whitish-ochreous. Legs grey, posterior pair whitish-grey. Forewings triangular, moderate, not very strongly dilated, costa nearly straight, slightly sinuate in middle, apex rounded, hindmargin oblique, both sinuations slight; very pale whitish-ochreous, almost wholly irregularly suffused with ochreous-fuscous, except an ill-defined patch in disc before first line, another on costa beyoud middle, and a third extending along lower two-thirds of hindmargin; a well-defined slender dark fuscous transverse line from costa at $\frac{2}{5}$ to inner margin before middle, hardly curved outwards, thrice rather strongly and irregularly dentate; a second dark fuscous transverse line from costa at $\frac{3}{4}$ to inner margin a little before anal angle, followed by a pale line of the ground-colour, margined posteriorly by the ochreous-fuscous suffusion, upper half irregularly curved outwards, lower half curved inwards, slightly sinuate above inner margin; a small irregularly oval clear white spot in disc beyond middle, suffusedly connected above with the pale costal patch; three small dark ochreous-fuscous spots near together on hindmargin below middle: cilia ochreous-grey-whitish, with a fuscous line near base, and an ill-defined white spot in each sinuation. Hindwings dark fuscous-grey; cilia grey-whitish, with a dark grey line near base.

A very distinct species, not particularly allied to any other, differing from all in the dark fuscous-grey hindwings, and the slightness of both hindmarginal sinuations; there are no metallic markings.

Taken commonly by Mr. R. W. Fereday, near Lake Wakatipu, in January.

9. *Dipt. elaina*, n. sp.

Male, female.—12–14 mm. Head, palpi, and thorax ochreous-grey-whitish, irregularly mixed with dark fuscous. Antennæ whitish-grey. Abdomen whitish-grey, apex more whitish. Legs grey-whitish. Forewings triangular, broad, costa very slightly arched, apex rounded, hindmargin rather strongly oblique, second sinuation slight; ochreous-grey-whitish, rather closely irrorated with dark fuscous, and with a slight irregular pale yellowish suffusion, causing a faint greenish tinge; the fuscous irroration is closest and darkest near base, along hindmargin, and on an indistinct median band; a dark fuscous transverse line from $\frac{1}{3}$ of costa to $\frac{2}{5}$ of inner margin, very slightly outwards-curved, thrice irregularly dentate, preceded by an indistinct pale line; a small black linear transverse spot in disc above and slightly beyond middle, above which is a suffused dark fuscous

spot on costa; an irregularly dentate dark fuscous transverse line from costa at $\frac{2}{3}$ to inner margin at $\frac{4}{5}$, followed by a pale line, suddenly bent outwards beneath costa, upper two-thirds rather strongly outwards-curved; a pale oblique mark on costa before apex, and a pale mark on anal angle: cilia grey-whitish, with two dark fuscous lines. Hindwings grey, with a dark grey hindmarginal line; cilia grey-whitish, with a dark grey line towards base.

Very distinct by its small size, grey colouring, and black linear discal spot.

I met with this species at Dunedin, Wellington, and Cambridge, amongst scrub in January. Mr. R. W. Fereday has taken it commonly at Christchurch at rest on old walls, and has furnished me with the following notes on the larva, which he finds in the same position. They are specially interesting, as this is the first larva of the genus which has been discovered.

"The full-grown larva about 9 lines in length, slender, rather flattened, wrinkled, of nearly uniform width, much contracted at the segmental divisions; the ground-colour varying from pale stone to ash-colour; down the middle of the back, on the fifth to the ninth segment inclusive, a series of dark purplish-brown or maroon marks, wedge-shaped, with the point of each wedge cleft, and somewhat resembling a W with the internal space filled up, and having the base of the wedge abutting on the anterior and the cleft end on the posterior extremity of the segment; a cream-coloured tubercular dot at the point of the cleft, and on the base of each dark mark a pair of similar but rather smaller dots; head dark, with a pale longitudinal stripe.

"Feeds on moss on damp walls; when at rest lies stretched out flat on the moss, and entirely exposed; forms in the moss a cocoon covered with dust and moss, hardly distinguishable."

Crambus, F.

Antennæ of male finely ciliated, rarely pectinated (not in New Zealand species). Labial palpi very long, attenuated. Forewings with 12 veins (rarely 11 through obsolescence of vein 9), 8 and 9 stalked, rising out of 7 (rarely 6 also rising out of 7). Hindwings with 8 veins, 4 and 5 usually stalked or from a point, 6 approximated at base to 7, 7 and 8 stalked, cell open.

Distinguished from all the other New Zealand genera of the family by the origin of the stalk of 8 and 9 out of 7, the close basal approximation of 6 and 7 in the hindwings, and the open cell. The genus is a very large one, being plentifully represented all over the world except in Australia, where it is almost absent. The larvæ feed amongst the roots of grass, and the perfect insects frequent dry grassy situations, and when met with are often very abundant.

I am acquainted with seventeen New Zealand species, which may be thus separated :—

I. Forewings with a sharply-defined white longitudinal streak from base to hindmargin.	
A. Streak above middle; costal area dark fuscous	12. *flexuosellus*.
B. ,, central; costal not darker than ground-colour	
1. Forewings blotched with dark fuscous	2. *corruptus*.
2. ,, not blotched	
a. Hindwings dark fuscous	1. *æthonellus*.
b. ,, light grey or whitish	
* Head light ochreous	
† Hindmargin dotted with black	6. *haplotomus*.
†† ,, not dotted	8. *simplex*.
** Head white	
† Cilia grey barred with white	11. *vittellus*.
†† ,, wholly white or whitish	
i. Costa with a rather broad white streak throughout	9. *siriellus*.
ii. ,, ,, a slender white streak throughout ..	7. *callirrhoüs*.
iii. ,, ,, a slender white streak from near base, posteriorly dilated	5. *dicrenellus*.
iv. ,, ,, a curved white streak from before middle to before apex	10. *apicellus*.
II. Forewings with no well-defined white longitudinal streak reaching hindmargin.	
A. With two slender longitudinal ferruginous streaks	17. *xanthogrammus*.
B. Without ferruginous streaks	
1. With a blackish or dark fuscous streak from base	
a. Forewings pale ochreous or whitish	3. *ramosellus*.
b. ,, grey	
* White basal streak hooked downwards in middle of disc	15. *harpophorus*.
** White basal streak straight beneath	16. ~~*strigosus*~~.
2. Without blackish basal streak	
a. Forewings whitish with a pale ochreous submedian streak	4. *angustipennis*.
b. ,, greyish	14. *cyclopicus*.
c. ,, brownish, with white and dark fuscous markings	13. *tuhualis*.

1. *Cr. æthonellus*, n. sp.

Male.—18–19 mm. Head, palpi, and thorax deep ochreous-brown, shoulders with a small yellowish-white spot; palpi rather short, beneath ochreous-white towards base. Antennæ dark fuscous. Abdomen dark fuscous, gradually suffused with pale ochreous posteriorly. Anterior and middle legs dark fuscous; posterior legs whitish-ochreous, apex of tarsi infuscated. Forewings short, moderately broad, costa almost straight, apex almost acute, hindmargin very slightly sinuate, nearly straight, moderately oblique; rather bright deep ochreous-brown; costal edge narrowly ochreous-

whitish, becoming gradually more ochreous towards base; inner marginal edge sometimes very narrowly ochreous-whitish; a straight moderately broad central longitudinal ochreous-white streak from base to hindmargin, attenuated on basal third and before hindmargin, more or less distinctly margined with dark fuscous: cilia pale whitish-ochreous, on basal third light grey, with a distinct ochreous-white spot on central streak. Hindwings dark fuscous; cilia ochreous-white or whitish-ochreous, with a grey basal line.

Easily distinguished from all the other New Zealand species by the nearly uniform dark fuscous hindwings with whitish-ochreous cilia. In form and general characteristics it is closely allied to *C. corruptus*, but differs widely in the deep ochreous-brown colouring, and the absence of the dark fuscous blotches. These two species are shorter-winged, more stoutly built, and more densely scaled than usual, but the venation is typical.

A mountain species; taken commonly by Mr. R. W. Fereday about Porter's Pass and Mount Hutt in January.

2. *Cr. corruptus*, Butl.

(*Hypochalcia corrupta*, Butl., Proc. Zool. Soc. Lond., 1877, 399, Pl. XLIII., 9.)

Male.—18–19 mm. Head dark fuscous, face and back of crown ochreous-whitish. Palpi moderate, dark fuscous mixed with greyish-ochreous, beneath whitish towards base. Antennæ dark fuscous. Thorax dark fuscous, sides more ochreous-fuscous, shoulders with a few ochreous-whitish scales. Abdomen dark fuscous, suffused with pale greyish-ochreous posteriorly. Legs whitish-ochreous, anterior and middle pair suffused with greyish-fuscous. Forewing short, moderately broad, costa almost straight, slightly sinuate in middle, apex almost acute, hindmargin very slightly rounded, rather strongly oblique; ochreous-brown; extreme costal edge suffusedly ochreous-whitish, towards base and apex dark fuscous; a slender very ill-defined white streak beneath costa from middle to apex; inner margin rather narrowly suffused with dull ochreous-grey-whitish, towards base very narrowly and margined above by a short dark fuscous streak; a straight rather narrow central longitudinal white streak from base to hindmargin, considerably attenuated towards both ends, lower edge indented beyond middle; a broad dark fuscous streak along each margin of central streak from near base to middle, attenuated anteriorly; a dark fuscous blotch on each margin of central streak about $\frac{2}{3}$, extending above to the subcostal white streak, and beneath to the dorsal whitish suffusion; a rather narrow dark fuscous band along hindmargin, interrupted by central streak, dilated towards costa: cilia grey, tips paler, with a rather darker grey basal line, on upper half of hindmargin more or less scaled with ochreous-white. Hindwings fuscous-grey, with a narrow dark fuscous hindmarginal band; cilia grey-whitish, with a grey basal line.

Very distinct through the combination of the dark fuscous blotches and white median streak. It has not the slightest affinity to *Hypochalcia*, which belongs to another family.

Taken commonly by Mr. R. W. Fereday on Mount Hutt in January. Butler's note would give the erroneous idea that the species was generally common. His figure is not good.

3. *Cr. ramosellus*, Dbld.

(*Crambus ramosellus*, Dbld., Dieff. New Zeal., Vol. II., 288; *Crambus rangona*, Feld., Reise der Novara, Pl. CXXXVII., 25.)

Male, female.—23–27 mm. Head white, with an ochreous-brown spot behind eye. Maxillary palpi white, at base ochreous-brown. Labial palpi long, white, externally and towards apex beneath ochreous-brown. Antennæ dark fuscous. Thorax brownish-ochreous, with a broad central longitudinal white stripe. Abdomen whitish-ochreous. Legs whitish-ochreous, anterior and middle pair brownish-tinged. Forewings elongate, moderately broad, in female rather narrower, costa moderately arched, apex acute, hind margin strongly sinuate, rather strongly oblique; pale brownish-ochreous, more ochreous-brown towards base; a very slender white line immediately beneath costa from base to middle, sometimes obsolete; an ill-defined white central longitudinal streak from base to hindmargin, attenuated towards base, lower margin indented beyond middle, basal two-thirds margined beneath by a suffused dark fuscous streak, upper margin often suffused into ground-colour; between this streak and costa on posterior half of wing the veins are suffusedly marked with white, and sometimes whole costal half of wing suffused with white except margins; a broad ill-defined white or whitish suffusion along inner margin; in female sometimes whole wing suffused with whitish, except the dark fuscous submedian streak; two transverse series of dark fuscous dots, acutely angulated outwards above middle, intersecting median streak, often obsolete, first from middle of costa to below middle of median streak, not reaching inner margin, second from costa at $\frac{3}{4}$ to before anal angle, rather sinuate beneath; a hindmarginal row of dark fuscous dots: cilia whitish-grey, slightly shining, with a darker ochreous-grey line near base. Hindwings grey-whitish or whitish-grey, towards hindmargin and especially apex darker grey; cilia whitish or whitish-ochreous, with a very faint darker line near base.

The dark fuscous submedian streak, together with the ochreous or whitish ground-colour, sufficiently distinguishes this species from all others; it, however, varies considerably in depth of colouring, in the extent of the whitish suffusion, and the distinctness of the transverse series of dots. In general northern specimens seem to be smaller, darker, and more distinctly marked than southern.

A very common and generally distributed species; taken at Hamilton, Wellington, Nelson, Mount Hutt, Akaroa, Christchurch, and Dunedin; probably universally common; in December, January, February, and April.

Doubleday's description is very clear and unmistakeable. Zeller, not being aware of this description, later described a totally different species of the genus from Europe under the same name, which cannot stand.

4. *Cr. angustipennis*, Z.

(*Chilo angustipennis*, Z., Hor. Ross, 1877, 15, Pl. I., 3; *Chilo leucanialis*, Butl., Proc. Zool. Soc. Lond., 1877, 401.)

Male, female.—29–44 mm. Head white, sides of crown pale brownish-ochreous. Maxillary palpi white, towards base light brownish-ochreous. Labial palpi very long, white, externally light brownish-ochreous. Antennæ whitish-fuscous. Thorax pale brownish-ochreous, with a broad white central longitudinal stripe, and margins of shoulders very narrowly white. Abdomen and legs ochreous-whitish. Forewings elongate, narrow, in female very narrow, not dilated posteriorily, costa in male moderately, in female slightly arched, apex in male very strongly, in female moderately produced, acute, hindmargin sinuate, very oblique; very pale dull ochreous; all veins on upper half of wing broadly suffused with white, nearly confluent, so that the whole costal half appears whitish; a rather broad white streak along inner margin from base to anal angle, suffusedly margined above at base with dark fuscous, and bordered on inner marginal edge by a slender fuscous streak from $\frac{1}{3}$ to anal angle, strongest in middle: cilia white. Hindwings white, sometimes slightly ochreous-tinged; cilia white.

Very distinct by its large size, narrow forewings, produced apex, and the white suffusion of the forewings leaving only a narrow longitudinal submedian band of the ochreous ground-colour. Zeller is certainly wrong in referring this species to *Chilo* on superficial grounds, since in venation it is a true *Crambus*, and its peculiarities of appearance are only exaggerations of essentially similar points in *C. ramosellus*, which is its nearest ally.

Not uncommon in the neighbourhood of Christchurch in December, January, and March, frequenting undoubtedly the toi-grass (*Arundo conspicua*).

Zeller's name has the priority, having been published 1st April, 1877, whilst Butler's does not appear to have been read until 1st May in the same year.

5. *Cr. dicrenellus*, n. sp.

Male, female.—28–32 mm. Head white, sides of crown and anterior margin of eyes brownish-ochreous. Maxillary palpi white, towards base ochreous-fuscous. Labial palpi moderately long, rather dark ochreous-fuscous, white internally and beneath at base. Antennæ dark fuscous.

Thorax ochreous-brown, with a suffused white central longitudinal stripe. Abdomen pale whitish-ochreous. Anterior and middle legs dark ochreous-fuscous; posterior legs ochreous-whitish. Forewings moderate, posteriorly dilated, costa very slightly arched, somewhat sinuate before middle, apex almost rectangular, hindmargin rather oblique, very faintly sinuate; rather light greyish-ochreous-brown, with a marked brassy-yellowish reflection; extreme costal edge very narrowly white throughout except at base, dilating into a broader ill-defined white suffusion at about ¾; a rather narrow sharply-defined white central longitudinal streak from base to hindmargin, rather attenuated towards base, very slightly curved near hindmargin, lower edge very indistinctly split a little before hindmargin; hindmarginal edge generally very narrowly white between central streak and costa; inner margin very narrowly and indistinctly suffused with whitish throughout more or less of its length: cilia whitish, base clear white. Hindwings pale whitish-fuscous-grey, hindmargin ochreous-tinged; cilia whitish.

Most allied to *C. vittellus* and *C. simplex*, resembling them in form of wing; from the former it differs by the costal edge being white nearly throughout, more brassy tint, larger size, and absence of distinct blackish hind-marginal dots, as well as by the whitish cilia; from the latter by the much darker colouring, more sharply-defined white markings, and absence of white suffusion on veins.

Taken plentifully by Mr. R. W. Fereday on Mount Hutt in January.

6. *Cr. haplotomus*, n. sp.

Male, female.—29–33 mm. Head light brownish-ochreous, with a narrow ill-defined whitish longitudinal stripe on each side above eyes, meeting above palpi. Maxillary palpi brownish-ochreous, apex whitish. Labial palpi moderate, brownish-ochreous, internally and at base beneath white. Antennæ dark fuscous. Thorax light brownish-ochreous. Abdomen pale ochreous. Anterior and middle legs greyish-fuscous; posterior legs grey-whitish. Forewings rather narrow, posteriorly dilated, costa at first very gently arched, more strongly on posterior half, faintly sinuate in middle, apex nearly rectangular, hindmargin moderately oblique, rather strongly rounded; greyish-ochreous, somewhat deeper on disc, with a slight brassy tinge; extreme costal edge very slenderly white from near base to apex; a very slender white line close beneath costa from base, merged in costal edge before middle; three or four slender indistinct short white streaks on veins towards posterior half of costa and apex; a narrow tolerably well-defined central longitudinal white streak from base to hindmargin, very slightly sinuate in middle and very slightly curved posteriorly, attenuated towards base; seven minute black dots on hindmargin: cilia whitish-grey. Hindwings pale grey, somewhat darker towards hindmargin; cilia whitish.

This species and *C. callirrhoüs* differ somewhat in form of wing from those most nearly allied to them, the forewings being somewhat less dilated and the hindmargin less perceptibly sinuate and more strongly rounded. *C. haplotomus* differs from all its nearest allies in the absence of the broad white thoracic stripe (only in the much paler *C. simplex* is this occasionally obsolete), and in the presence of a complete hindmarginal row of minute black dots.

Several specimens taken by Mr. R. W. Fereday near Lake Wakatipu in January.

7. *Cr. callirrhoüs*, n. sp.

Male.—24–27 mm. Head white, with a pale brownish longitudinal spot on face, and posterior margin of eyes ochreous-brown. Maxillary palpi white, towards base externally ochreous-brown. Labial palpi long, white, externally ochreous-brown. Antennæ dark fuscous. Thorax brownish-ochreous, a broad central longitudinal stripe and margins of shoulders white. Abdomen ochreous-whitish, more ochreous towards base. Anterior and middle legs greyish-fuscous, posterior legs white. Forewings moderate or rather narrow, costa at first very gently arched, more strongly on posterior half, distinctly sinuate in middle, apex nearly rectangular, hind margin moderately oblique, slightly sinuate below apex, strongly rounded beneath; greyish-ochreous, rather deeper on disc, with a more or less distinct brassy-yellowish tinge; a slender white streak along costa throughout; veins on posterior two-thirds of wing above median streak indicated by slender white lines, partially suffused and confluent on costa about $\frac{3}{4}$; a slender almost straight central longitudinal white streak from base to hindmargin, slightly sinuate in middle; sometimes a slender white streak along vein 2 towards hindmargin; a narrow white streak, very slender at extremities, along inner margin from base, leaving inner margin at about $\frac{1}{4}$ and continued very near it to anal angle, posteriorly suffused: cilia shining whitish. Hindwings whitish-grey, somewhat darker posteriorly, hindmargin slightly ochreous-tinged; cilia white.

Distinguished from all its allies by the distinctness of the slender white streaks on the veins; from *C. haplotomus*, which it most nearly resembles, also by the smaller size, and broad white stripe on thorax.

I have met with this elegant species only on sandhills near Christchurch; in February and March; Mr. R. W. Fereday has taken it, with other species usually frequenting coast sandhills, at Lake Guyon.

8. *Cr. simplex*, Butl.

(*Chilo simplex*, Butl., Proc. Zool. Soc. Lond., 1877, 400, Pl. XLIII., 12.)

Male, female.—27–32 mm. Head pale ochreous, anterior margin of eyes and a spot on crown more or less whitish. Maxillary palpi white, towards

base externally brownish - ochreous. Labial palpi long, white, externally greyish-ochreous, more fuscous towards apex. Antennæ dark fuscous. Thorax light ochreous, with a more or less distinct suffused white central longitudinal stripe, sometimes obsolete. Abdomen ochreous-whitish, more ochreous towards base, apex white. Anterior and middle legs whitish-ochreous, suffused beneath with dark fuscous; posterior legs whitish. Forewings moderate, in female narrow, costa moderately arched, less strongly in female, slightly sinuate in middle, apex acute, in female rather produced, hindmargin rather strongly oblique, slightly rounded; pale ochreous; a very slender white streak from base close beneath costa to apex, on posterior half broader and more suffused, in female broader and extending to costa; veins towards hindmargin between median streak and costa more or less suffused with white, more strongly in female; a rather narrow central longitudinal white streak from base to hindmargin, rather attenuated towards base, very slightly curved towards hindmargin; sometimes a slender white streak along vein 1 towards anal angle; in female, veins somewhat suffused with white towards hindmargin beneath median streak; a very slender white streak along inner margin from base to beyond middle, posteriorly suffused: cilia shining white. Hindwings very pale whitish-grey, in female white, hindmargin faintly ochreous-tinged; cilia white.

Differs from all the allied species by the clear pale ochreous ground-colour; the white markings (except the central streak) are more suffused, the cilia clear white, and the hindwings paler, being quite white in female. In this and the allied species the central streak appears dark-margined in part, but the effect is illusory, and due to the presence of deep folds.

Very common round Christchurch in November, December, February and March, seemingly attached to the tussock-grass.

9. *Cr. siriellus*, n. sp.

Female.—26–30 mm. Head white, sides of crown dark brown. Maxillary palpi white, towards base externally brown. Labial palpi moderate, white, externally brown. Antennæ dark fuscous. Thorax dark ochreous-brown, on sides posteriorly paler and whitish-tinged, with a broad white central longitudinal stripe. Abdomen ochreous-whitish. Anterior and middle legs whitish-ochreous, beneath suffused with dark fuscous; posterior legs whitish. Forewings moderate, somewhat dilated, costa moderately arched, apex acute, hindmargin nearly straight, moderately oblique; dark brown, becoming ochreous towards the inner and hindmargins; a narrow silvery-white costal streak from base to apex, attenuated on basal half, posteriorly suffused, extreme costal edge sometimes brown about $\frac{2}{3}$; a moderate nearly straight

central longitudinal silvery-white streak from base to hindmargin, rather narrower towards base, lower edge slightly indented beyond middle; faint indications of whitish lines on veins towards hindmargin; a whitish suffusion along inner margin from base to anal angle, very narrow at base, posteriorly indistinct or obsolete: cilia white. Hindwings whitish-grey, towards apex and hindmargin fuscous-grey; cilia white.

A distinct species, immediately known by the dark brown ground-colour, and narrow silvery-white costal streak extending from base to apex. It is perhaps this species which Butler speaks of (Proc. Zool. Soc. Lond., 1877, 400) as *lativittalis*, Walk.; the true *lativittalis* (which is a species of *Thinasotia*, and most certainly does not occur in New Zealand) is superficially somewhat similar, but has the thorax wholly brown, and many other points of distinction.

Two specimens taken in a swamp near Hamilton in January.

10. *Cr. apicellus*, Z.

(*Crambus apicellus*, Z., Mon. Cr., 31.)

Male.—24–25 mm. Head snow-white, sides of crown ochreous-brown. Maxillary palpi white, towards base externally reddish-ochreous-brown. Labial palpi moderate, white, externally reddish-ochreous-brown. Antennæ dark fuscous. Thorax ochreous-brown, posteriorly on sides paler and whitish-tinged, with a broad central longitudinal white stripe. Abdomen whitish-ochreous. Legs whitish-ochreous, suffused with dark fuscous beneath. Forewings moderate, posteriorly dilated, costa gently-arched, apex rounded-acute, hindmargin rather oblique, distinctly sinuate; reddish-ochreous-brown, much lighter towards inner margin; a slightly curved narrow white streak from costa before middle to costa a little before apex, enclosing a slender brownish-ochreous costal streak; a small triangular white spot on hindmargin above median streak; a moderate central longitudinal snow-white streak from base to hindmargin, rather attenuated at base, slightly sinuate in middle, and very slightly curved towards hind margin, lower edge somewhat irregular beyond middle; a whitish suffusion along inner margin from base to beyond middle, very narrow at base, posteriorly indistinct; three elongate ill-defined black dots on hindmargin beneath median streak; a fuscous hind-marginal line, bordering the white markings: cilia shining grey-whitish, at base white. Hindwings fuscous-grey, towards base suffused with whitish-ochreous; cilia whitish-ochreous.

A handsome species, very distinct by the peculiar form of the costal streak, and the sharply-defined small white triangular spot on hindmargin.

Occurs at Hamilton, Christchurch, and at the foot of Mount Hutt, frequenting swampy places in January.

11. *Cr. vittellus*, Dbld.

(*Crambus vittellus*, Dbld., Dieff. New Zeal., Vol. II., 289; *Crambus nexalis*, Walk., Brit. Mus. Cat., 178; *Crambus transcissalis*, ibid., 178; *Crambus sublicellus*, Z., Mon. Cr., 31; *Crambus bisectellus*, ibid., 32; *Crambus incrassatellus*, ibid., 32; *Crambus vapidus*, Butl., Proc. Zool. Soc. Lond., 1877, 399.)

Male, female.—20–25 mm. Head white, a spot on face and posterior margins of eyes very pale greyish-ochreous. Maxillary palpi white, towards base externally greyish-ochreous. Labial palpi moderately long, white, externally greyish-ochreous or brownish-ochreous. Antennæ dark fuscous. Thorax white, more or less ochreous on sides. Abdomen ochreous-whitish, more ochreous towards base. Legs whitish, beneath suffused with dark fuscous. Forewings moderate, in female rather narrow, costa gently arched, apex rounded-acute, hindmargin nearly straight or very slightly sinuate, moderately oblique; greyish-ochreous or brown, darkest on costal half; sometimes irrorated with whitish scales towards inner margin and posterior half of costa; often a more or less distinct suffused white streak extending along more or less of posterior half of costa, broadest at ¾; a moderate nearly straight central longitudinal white streak, rather attenuated at base, extending to hindmargin, sometimes attenuated posteriorly, margins often irregular on posterior half, sometimes suffusedly margined with dark fuscous on basal half beneath and on posterior half above, often irregularly interrupted by the transverse lines; extremity of median streak produced upwards into a narrow white projection along hindmargin nearly to apex; sometimes two transverse darker lines or series of spots, more or less distinctly cutting median streak, first from middle of costa to ⅓ of inner margin, very acutely angulated above streak, second from ¾ of costa to before anal angle, less acutely angulated; inner margin sometimes white towards base; three or four tolerably distinct black dots on hindmargin below middle; a tolerably distinct slender dark fuscous hindmarginal line: cilia shining-grey or whitish-grey, with a somewhat darker basal line, three or four slender white bars on upper half, sometimes confluent at base, and another above anal angle. Hindwings whitish-fuscous-grey, paler towards base, darker at apex; cilia ochreous-grey-whitish.

This very common and very variable species, which may be regarded as the type of the New Zealand representatives of the genus, may in all its forms be sufficiently well distinguished from those with which it is most likely to be confused, by the white bars of the cilia, and the black hind marginal dots below median streak. It most approaches *C. dicrenellus* and *C. flexuosellus*, differing further from the former in the white costal suffusion not extending towards base, and from the latter in the central position of the white streak, and the paler costal area.

Occurs at Hamilton, Cambridge, Christchurch, Ashburton, and at the foot of Mount Hutt, from January to March, generally in abundance; it is probably universally distributed.

Prof. Zeller kindly forwarded to me his unpublished figures of the specimens from which his descriptions quoted above were taken, enabling me to decide that they were all truly referable to varieties of this species.

12. *Cr. flexuosellus*, Dbld.

(*Crambus flexuosellus*, Dbld., Dieff. New Zealand, Vol. II., 289; Feld., Reise der Novara, Pl. CXXXVII., 32.)

Male, Female. — 20–24 mm. Head and palpi rather dark ochreous-fuscous; labial palpi moderate, white beneath. Antennæ fuscous-grey. Thorax ochreous grey or light greyish-fuscous. Abdomen whitish-grey-ochreous. Legs whitish-ochreous, more or less wholly suffused with dark fuscous. Forewings moderate, somewhat dilated posteriorly, costa gently arched, very slightly sinuate in middle, apex obtuse, hindmargin little oblique, slightly sinuate; rather light greyish-fuscous, sprinkled with dark fuscous, costal space above white streak dark fuscous; a well-defined straight moderately broad longitudinal white streak above middle from base to hindmargin immediately beneath apex, upper edge very near costa on basal $\frac{2}{5}$, thence twice sinuate to apex, lower edge twice irregularly dentate beyond middle; an indistinct dark spot on lower edge before middle, and a dark fuscous spot in first indentation, indicating first transverse line; second transverse line tolerably distinct, dark fuscous, closely but indistinctly dentate, from costa at $\frac{3}{4}$ to inner margin at $\frac{4}{5}$, angulated outwards on lower edge of white streak, obsolete on costa, where it is often followed by a suffused ochreous mark; a slender dark fuscous hindmarginal line; three or four minute black dots on hindmargin below middle: cilia shining-grey, with a dark-grey line near base, and a white basal line on upper half, produced into a white bar at apex. Hindwings dull whitish-ochreous, apex fuscous-grey, hindmargin more or less suffused with light fuscous-grey; cilia whitish-ochreous, with two faint grey lines.

Very distinct by the ochreous-fuscous head and palpi, the position of the white streak above middle, and the dark fuscous costal space.

Occurs at Hamilton, Wellington, Christchurch, Dunedin, and probably everywhere, abundantly from December to April.

13. *Cr. tuhualis*, Feld.

(*Crambus tuhualis*, Feld., Reise der Novara, Pl. CXXXVII., 18; *Crambus vulgaris*, Butl., Proc. Zool. Soc. Lond., 1877, 400, Pl. XLIII., 7.)

Male, female.—20–25 mm. Head brownish-ochreous or fuscous. Palpi greyish fuscous or dark fuscous, labial palpi moderate, beneath whitish.

Antennæ fuscous-grey. Thorax greyish-fuscous. Abdomen whitish-ochreous. Legs whitish-ochreous, anterior and middle pair suffused with greyish-fuscous. Forewings moderate, somewhat dilated posteriorly, costa moderately arched, hardly sinuate, apex rounded-acute, hindmargin oblique, straight or slightly sinuate; rather light ochreous-grey-brown, costal half suffused with dark fuscous; more or less irregularly irrorated with white on costal half, and towards base and hindmargin; a narrow irregular suffused white streak above middle from base to disc before middle, posteriorly obliquely truncate, sometimes almost interrupted at $\frac{1}{4}$; a rather broad irregular suffused often nearly obsolete white transverse line from middle of costa to before middle of inner margin, passing through extremity of streak from base; an elongate-oval longitudinal white spot in middle of disc, almost connected with basal streak; above and rather beyond this the obsolescence of the white irroration causes a dark blotch on costa; a broad suffused white closely dentate transverse line from costa at $\frac{3}{4}$ to inner margin at $\frac{4}{5}$, anteriorly finely edged with dark fuscous, somewhat bent inwards beneath costa and angulated outwards above middle; a suffused white somewhat triangular blotch on hindmargin immediately beneath apex, margined above by a dark spot, and suffusedly and indistinctly produced downwards towards anal angle; lower veins towards hindmargin indistinctly dark fuscous; four minute black dots on lower part of hindmargin; a slender dark fuscous hindmarginal line: cilia whitish-grey, somewhat mixed or very indistinctly barred with white, with a slender white basal line on upper half, produced into an apical bar. Hindwings whitish-grey-ochreous, hind margin narrowly suffused with light fuscous-grey; cilia whitish-ochreous, with a faint grey line near base.

Allied to *C. flexuosellus*, but differing widely in the white irroration and transverse lines, and the absence of a complete white longitudinal streak.

Common on the hills near Christchurch; also taken at Wellington, on the Kaikoura range, and in the Rakaia district; in February and March.

Felder's and Butler's figures are about equally poor, but can hardly refer to any other insect.

14. *Cr. cyclopicus*, n. sp.

Male, female.—20–25 mm. Head, palpi, and thorax whitish, coarsely irrorated with fuscous-grey; labial palpi long. Antennæ dark fuscous. Abdomen whitish-ochreous. Legs dark grey, middle tibiæ with some white scales and a white apical ring, posterior tibiæ white with a few grey scales, middle and posterior tarsi with white rings at apex of joints. Forewings rather narrow, more or less distinctly dilated posteriorly, costa gently arched, apex almost acute, hindmargin gently rounded, rather strongly

oblique; white, closely and finely irrorated with dark grey; generally a slight brownish or ochreous tinge along basal two-thirds of costa, sometimes extending over whole wing; sometimes a dark grey suffusion on middle of costa; a small dark fuscous elongate mark on inner margin close to base; a double indistinct dentate dark grey line from costa before middle to inner margin at $\frac{2}{5}$, often wholly absent or obsolete; a dark grey circular ring in disc slightly beyond middle, in centre of which is a dark grey elongate dot, both often absent, or the dot only visible; a double often well-defined dentate dark grey line from costa at $\frac{4}{5}$ to inner margin before anal angle, shortly angulated inwards immediately beneath costa, and outwards above middle, often wholly absent; a dark fuscous hindmarginal line; a row of from six to eight small black dots on hindmargin: cilia light shining-grey, more or less distinctly narrowly barred with white, with a darker grey line near base, and extreme base white. Hindwings ochreous-grey-whitish, hindmargin narrowly suffused with light fuscous-grey; cilia ochreous-whitish.

Very variable, but very distinct by the narrow wings, grey colouring, and entire absence of white markings or longitudinal streak.

Abundant on the hills round Christchurch in March; I have also seen specimens from Lake Guyon, which were somewhat larger, with the dark markings more intense.

15. *Cr. harpophorus*, n. sp.

Male.—26–27 mm. Head whitish, with a faint ochreous spot in middle of face, and posterior margin of eyes greyish-ochreous. Maxillary palpi white, towards base externally dark fuscous mixed with ochreous. Labial palpi moderate, fuscous-grey, internally and at base beneath snow-white. Antennæ dark fuscous. Thorax grey, with a whitish spot in middle of anterior margin. Abdomen grey-whitish, posteriorly suffused with pale ochreous. Legs light fuscous-grey, posterior pair more whitish. Forewings rather narrow, posteriorly dilated, costa slightly sinuate in middle, gently arched posteriorly, apex rounded, hindmargin moderately oblique, rounded; grey, very slightly brownish-tinged; a slender ill-defined central streak of white scales from base to beyond middle of disc, its extremity bent downwards and then sharply turned inwards to form a strong hook; upper edge of this streak margined by a very slender dark grey line, forming an abrupt spot on extremity, lower edge margined by a dark fuscous-grey streak, filling up the hook; a slender ill-defined sinuate longitudinal streak of white scales in disc from $\frac{1}{3}$ to $\frac{2}{3}$, its anterior extremity resting on upper margin of basal streak, its lower edge broadly and suffusedly margined with dark fuscous-grey until it touches basal streak, its upper edge marked with a dark fuscous dot before extremity, surrounded with a few whitish scales;

a transverse series of tolerably distinct elongate dark fuscous dots crossing wing from $\frac{3}{4}$ of costa to inner margin before anal angle, strongly angulated outwards in middle; veins posteriorly indistinctly marked with lines of whitish scales; a very fine dark grey hindmarginal line: cilia grey, indistinctly barred with whitish, and with extreme base whitish. Hindwings grey-whitish; cilia whitish, with a faint grey line.

Easily known from *C. strigosus* by the hook on the lower margin of the central streak, and the much narrower forewings.

Mr. R. W. Fereday took several specimens near Lake Wakatipu in January.

Thinasotia claviferella Walk

16. ~~Cr. strigosus, Butl.~~ See Vol XX p 69

(*Aphomia strigosa*, Butl., Proc. Zool. Soc. Lond., 1877, 398, Pl. XLIII., 10.)

Male.—27–30 mm. Head, palpi, and thorax light greyish-ochreous, thorax sometimes mixed with blackish-fuscous; anterior margin of eyes very slenderly whitish; labial palpi moderately long, mixed with dark fuscous externally, beneath whitish at base. Antennæ fuscous-grey. Abdomen ochreous-whitish, apex more ochreous. Legs ochreous-grey-whitish, anterior and middle pair suffused above with dark fuscous. Forewings rather broad, considerably dilated posteriorly, costa gently arched, very faintly sinuate before middle, apex rounded, hindmargin oblique, strongly rounded; rather light brownish-grey, more brownish in disc, irregularly irrorated with black and white scales; veins posteriorly indistinctly lined with white scales; a short slender suffused blackish streak beneath costa at base; a straight thick longitudinal black streak beneath middle from base to middle of disc, much attenuated at base, lower edge suffused towards extremity; a short thick very oblique black streak in disc above extremity of basal streak, uniting with it to form a pointed hook; basal streak generally margined above by an ill-defined ochreous-white streak filling up the hook, sometimes suffusedly extending towards base almost to costa, sometimes almost obsolete; a very elongate-elliptical slender blackish ring in disc above middle, often partially obsolete; a blackish suffusion between branches of submedian vein at base; a strongly and regularly dentate outwards-curved slender blackish transverse line from $\frac{4}{5}$ of costa to $\frac{4}{5}$ of inner margin, sinuate beneath, posteriorly margined by a whitish suffusion; a row of distinct black dots on hindmargin: cilia whitish mixed with light grey, faintly barred. Hindwings grey-whitish, slightly suffused posteriorly with fuscous-grey; a cloudy grey line towards hindmargin below apex; hindmargin narrowly and suffusedly darker fuscous-grey; cilia grey-whitish.

A very distinct species, with the forewings broader than usual; allied to the preceding.

Not uncommon at light in Christchurch during March; Mr. R. W. Fereday has also taken it commonly at Mount Hutt in January.

The species does not bear the slightest affinity or resemblance to *Aphomia*, which differs widely in venation, belonging as it does to another family, and further has entirely different, very short, ascending palpi in the male, a character of which Butler, though describing a male, was evidently unaware.

17. *Cr. xanthogrammus*, n. sp.

Male.—22–24 mm. Head reddish-ochreous, mixed with grey on face; anterior margin of eyes, lower part of face, and a small spot on crown whitish. Maxillary palpi whitish, towards base externally reddish-ochreous. Labial palpi rather long, reddish-ochreous, internally whitish, beneath white at base. Antennæ dark fuscous. Thorax light grey, somewhat mixed with whitish, with a spot on each shoulder and centre of back reddish-ochreous. Abdomen grey-whitish, suffused with light ochreous. Anterior and middle legs dark grey, apex of middle tibiæ and of first joint of tarsi whitish; posterior legs whitish, tarsal joints suffused with dark grey except towards apex. Forewings moderate, posteriorly dilated, costa slightly arched, somewhat sinuate before middle, apex rounded, hindmargin rather oblique, strongly rounded; whitish, becoming clearer white towards costa, and grey towards inner margin posteriorly; a short dark brownish-grey mark on inner margin at base; an oblique irregularly oval dark brownish-grey blotch in disc towards base, its anterior extremity connected with base by a short streak, its posterior extremity almost touching inner margin at $\frac{1}{3}$; a slender dark brownish-grey transverse fascia from middle of costa to middle of inner margin, becoming much thicker on lower half, suffused on costa, upper half irregularly dentate above middle, sending a sharp tooth inwards in middle; a second slender dark brownish-grey transverse fascia from costa at $\frac{3}{4}$ to inner margin at $\frac{4}{5}$, strongly and abruptly dilated on lower third, upper two-thirds twice curved inwards, sending a sharp tooth outwards between the curves, anterior edge below middle emitting two or three slender lines along veins to centre of disc; this fascia is margined posteriorly by a suffused white fascia, beyond which is a brownish-grey hind-marginal band irrorated with whitish; a straight slender bright ferruginous streak along submedian vein from base to second fascia, indistinct towards base; a more conspicuous straight slender bright ferruginous streak from base to anal angle; both these streaks intersect all the dark markings they meet; lower half of hindmargin tinged with ferruginous: cilia grey, with a white basal line on upper half of hindmargin. Hindwings grey-whitish, with a faint cloudy grey line a little before hindmargin, and a grey hind-marginal line; cilia whitish, with a faint grey line near base.

A peculiar and very elegant species, not nearly allied to any other, and immediately recognizable by the ferruginous longitudinal streaks; it has more the general appearance of some of the *Phycidæ*, but it is a true *Crambus*.

Two specimens taken by Mr. R. W. Fereday in March near Lake Coleridge.

NOTE.—*Crambus sabulosellus*, Walk., *C. trivirgatus*, Feld., and *C. rotuellus*, Feld., do not belong to this family at all, and are therefore not referred to above.

[*Read before the Philosophical Institute of Canterbury, 7th September*, 1882.]

II.—TORTRICINA.

The *Tortricina* of New Zealand are less numerous than at first sight they appear to be, or than would be inferred from a study of authors. Walker described 40 species, but after the removal of synonyms, and unidentifiable descriptions of which the types have been lost, these are reducible to 12. Zeller has added one new species. Felder has described 9, out of which (excluding *Pædisca mahiana*, which is unknown to me, but perhaps not a New Zealand species) only one is new. Butler has, also, described 7, of which only two are new. I have previously described 9 others, and now give descriptions of 11 additional species, which, with two naturalized European insects, bring up the entire number to only 38.

I have been led by a fuller acquaintance with the New Zealand species, which are presumably in the main of old types, to modify the views expressed in my paper on the Australian *Tortricina* (Proc. Linn. Soc. of New South Wales, 1881) as to the process of development of the *Tortricidæ*. The genus *Harmologa* and the additional species of *Proselena* furnish so strong a connecting link between their own group (or that of *Acropolitis*), and that of *Tortrix* and *Cacoecia*, that I see no other way of accounting for it, except on the supposition that this group is the oldest of the three principal ones, and that the groups of *Dichelia*, on the one hand, and of *Tortrix*, on the other, both sprang from it in diverging lines. The genus *Prothelymna* further supplies the nearest approach known to me in these regions towards the type from which this oldest group must have arisen. It is impossible to arrange a linear order so as to clearly show these relations, but I think them quite apparent. The history of the special distinguishing character of the *Acropolitis group*, the separation at origin of veins 3 and 4 of the hindwings, is thus satisfactorily made out; the group originates from the *Chimabacchidæ*, a small family specially characterized by this same structure, but in the *Depressaridæ* and *Œcophoridæ*, which are very extensive families, and the parents of the *Chimabacchidæ*, this character is entirely absent; the tendency to reversion in this particular has evidently been very strong, since in all three families of the *Tortricina* the character has disappeared from all but the oldest types. So marked is this result,

that out of about 650 European *Tortricina* only about a dozen, or two per cent. possess this structure; though in Australia the proportion is sixteen per cent. and in New Zealand thirty-six per cent.

The New Zealand *Tortricina* are of a very fragmentary sort; even those that are congeneric are very rarely at all closely allied specifically. The fauna certainly strikes one as not having been developed on the spot from a few types, but as being the broken remains of a much more extensive one; though it might possibly have been derived by scanty immigration from different sides. Unfortunately there is practically little or nothing known of the South American *Tortricina*, nor of those of the South Pacific Islands. The affinity with Australia is, however, clear.

The *Tortricidæ* are represented by 11 genera; of these 4 are cosmopolitan, 4 Australian, and 3 (so far as known) endemic. Of the cosmopolitan genera, the single species of *Capua*, and three species of *Tortrix*, are closely allied to Australian forms. Two, however, of the endemic genera, viz., *Prothelymna* and *Eurythecta*, are widely remote from any known Australian genera. The entire absence of *Teras* and *Sciaphila*, a marked characteristic of Australia, is here equally noticeable. Eight genera of *Grapholithidæ* occur; but of these, two are not indigenous; and a third, *Strepsiceros*, is represented only by two species, which both also occur in Australia, being the only two *Tortricina* apparently native to both countries. As this genus is considerably developed in Australia, of which it is peculiarily characteristic, and as there are no known species peculiar to New Zealand, I am disposed to think that both of these must have been in some way artificially introduced.* Of the remaining five genera, four are isolated and endemic, containing each a single species, three of them having some apparent affinity with *Strepsiceros*; the fifth, *Pædisca*, is the solitary representative of the large group of genera closely allied to *Grapholitha*, dominant in Europe and North America, but absent from Australia, so that this species is locally quite isolated. The *Conchylidæ* are represented by only one genus, found also in Australia, and of a group characteristically Australian; there are structural reasons for supposing this genus to be one of the oldest types of its family. On the whole, therefore, it will be seen that the fauna is distinctly Australian in character, with some few curious and at present inexplicable exceptions.

* With regard to the introduction of the two species of *Strepsiceros* here mentioned, I may suggest that it is sometimes stated, (I know not with what truth), that the leaves of the *Leptospermum*, on which the larvæ of both feed, were used by the sailors of Captain Cook as a substitute for tea; and it is therefore conceivable that, when leaving Port Jackson, where the plant and both the insects in question are found, they, being ignorant that the plant was equally common in New Zealand, might have brought a supply of branches with them. *S. ejectana* is so abundant near Sydney, that a small consignment of these could hardly fail to introduce it successfully.

A striking feature is the extreme variability of most of the species. Of those of which I possess sufficiently extensive series to form any judgment, two-thirds are highly inconstant in colouring, and frequently also in size. By a careful selection of types, and exclusion of intermediate forms, some of these, such as *Adox. conditana* and *Pæd. obliquana*, could easily be made to do duty as a dozen species in the estimation of those who had not observed them at large, and, in fact, to this variability is due in part the large number of synonyms attached to them. It would seem from this, (in conjunction with the fact that such larvæ as are known are mostly polyphagous, and have readily adapted themselves to introduced European plants), that there have been no sufficient causes in operation to fix special types; it is possible that this may be in some measure due to the broken character of the fauna, and absence of closely allied species. It has also occurred to me, that, considering the very large number of new stations available for these insects on European plants, which have very rarely introduced any of their own *Lepidoptera* with them, and considering also the great pliability of character evidenced by the variability of colouring and larval habit, we have here every natural facility offered for the production of new species. It is very desirable that attention should be directed to this at once, since the process could only be detected by careful and continuous observation.

Some species were wrongly classified in my paper cited above, owing in most instances to the want of material for a proper examination, my New Zealand specimens there described having been all obtained in a month's tour. I have given descriptions here of all the species, in order to afford a sufficient base of operations for the New Zealand student, without other works; but in the case of species which I have already described elsewhere, I have not given quite the amount of detail which is necessary in a first description.

TORTRICINA.

Head rather rough; ocelli present; tongue short (rarely obsolete). Antennæ short. Maxillary palpi absent. Labial palpi rather stout, more or less porrected. Wings usually broad. Forewings with 12 veins (rarely 11 or 10, by coalescense of 7 and 8, and further of 3 and 4), 7 and 8 sometimes stalked, rest separate, vein 1 furcate at base (rarely one fork obsolete). Hindwings with 8 veins (sometimes 7 by coalescence of 3 and 4), 3 and 4 often stalked, sometimes separate, 6 and 7 often stalked.

Fam 1.—TORTRICIDÆ.

Lower median vein of hindwings without basal pectination; vein 2 of forewings rising before posterior third of lower margin of cell.

The following is a tabulation of the New Zealand genera :—

I. Forewings with 12 veins.
  A. Veins 7 and 8 of forewings stalked.
    1. Forewings with costal fold in male.
      a. Veins 3 and 4 of hindwings separate.
        i. Thorax crested .. .. 3. *Pyrgotis.*
        ii. „ smooth .. .. 4. *Adoxophyes.*
      b. Veins 3 and 4 of hindwings from a point .. .. .. 2. *Capua.*
    2. Forewings simple .. .. 1. *Dichelia.*
  B. Veins 7 and 8 of forewings separate.
    1. Forewings with costal fold in male.
      a. Veins 3 and 4 of hindwings separate.. .. .. .. 6. *Harmologa.*
      b. „ „ „ from a point .. .. .. 7. *Cacoecia.*
    2. Forewings simple.
      a. Veins 3 and 4 of hindwings separate.
        i. Antennæ shortly and simply ciliated .. .. .. 5. *Proselena.*
        ii. „ biciliated with long cilia .. .. .. 11. *Prothelymna.*
      b. Veins 3 and 4 of hindwings from a point.
        i. Veins 6 and 7 of hindwings separate .. .. .. 8. *Tortrix.*
        ii. „ „ „ stalked .. .. .. 9. *Dipterina.*
II. Forewings with 10 veins .. .. 10. *Eurythecta.*

1. Dichelia, Gn.

Thorax smooth (rarely crested). Antennæ shortly ciliated in male. Palpi rather short, porrected, densely rough-scaled above and generally beneath, often tufted beneath. Forewings with costa simple in male. Hindwings hardly broader than forewings. Forewings with 12 veins, 7 and 8 stalked, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 from a point or stalked, 5 approximated to 4 at base, 6 and 7 stalked.

Immediately distinguished from the other genera with veins 7 and 8 of the forewings stalked, by the absence of the costal fold in male. Only one New Zealand species is known, but the genus is well represented in Australia.

1. *Dich. luciplagana*, Walk.

(*Pædisca luciplagana*, Walk., Brit. Mus. Cat., 381; (*Dichelia*), Meyr., Proc. Linn. Soc. N.S.W., 1881, 470.)

Media, alis ant. dilutissime ochreis, triangulo costæ magno saturate fusco, spatio incluso semiovali sæpius albo, macula marginis postici elongata ciliisque saturate fuscis; post. albidis, apice leviter ochreo.

Male, female.—18–19½ mm. Head and thorax whitish-ochreous. Forewings moderate, posteriorly dilated, costa arched towards base, faintly sinuate in middle, hindmargin sinuate, oblique; whitish-ochreous, finely strigulated and sometimes suffused with darker; a moderately broad dark reddish-fuscous outwardly oblique streak from costa at ⅓, and a similar inwardly oblique streak from costa at ⅔, uniting on disc below middle so as to form a triangle enclosing a semi-oval white or pale ochreous patch; a

cloudy elongate semi-oval fuscous blotch along hindmargin from apex to anal angle; all these markings sometimes very faint: cilia dark fuscous, mixed with paler towards anal angle. Hindwings whitish, towards apex faintly ochreous-tinged, towards inner margin coarsely spotted with grey; cilia whitish.

A very distinct species, apparently allied to the Australian *D. isoscelana*, Meyr.

Tolerably common at Blenheim, Christchurch, and Dunedin, in January and February.

2. CAPUA, Stph.

Thorax smooth or slightly crested. Antennæ ciliated in male. Palpi moderate, porrected, second joint triangularly scaled. Forewings in male with strong costal fold, often concealing an expansible tuft of hairs. Hindwings somewhat broader than forewings. Forewings with 12 veins, 7 and 8 stalked, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 from a point or stalked, 5 somewhat approximated to 4 at base, 6 and 7 stalked.

Differs essentially from *Dichelia* only by the costal fold. Rather numerous in Australia, but there is only one New Zealand species.

2. *Cap. semiferana*, Walk.

(*Teras semiferana*, Walk., Brit. Mus. Cat., 306, (*Capua*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 453; *Sciaphila detritana*, Walk., Brit. Mus. Cat., 356; *Tinea admotella*, ibid., 485; *Grapholita abnegatana*, ibid., 991.)

Parva, alis ant. griseo-ochreis rufisve, striga disci obliqua prope basim nigrescente, fascia media angusta perobliqua saturate fusca, strigam disci nigram includente, macula costæ ante apicem triangulari fusca cum fascia sæpius conjuncta, omnibus interdum obsoletis; post. griseis.

Male, female.—11–15 mm. Head and thorax greyish-ochreous or fuscous, face and palpi internally pale-ochreous. Forewings moderate, in male dilated, costa moderately arched, hardly bent, hindmargin nearly straight, oblique; varying from light greyish irrorated with fuscous, to reddish-ochreous or reddish fuscous, often closely and irregularly strigulated with dark fuscous; costa and inner margin coarsely strigulated with blackish; outer edge of basal patch often represented by an irregular inwardly oblique blackish mark in disc near base; often an ill-defined dark spot on inner margin before middle; central fascia moderate, irregular, nearly evenly broad, from before middle of costa to before anal angle, dark fuscous, containing a blackish longitudinal mark above middle, lower half often wholly obsolete, upper half often confluent posteriorly with a dark fuscous elongate-triangular patch on costa towards apex, so as to form a larger triangular blotch; an irregular dark fuscous streak near hindmargin, often absent; sometimes all markings absent, or the wing streaked

longitudinally with dark fuscous; a blackish interrupted hindmarginal line: cilia pale ochreous or reddish-ochreous, mixed with blackish round apex, often with a blackish line towards base, towards anal angle whitish-tinged. Hindwings grey; cilia pale grey, with a darker basal line.

A very variable species, in size, colour, and irregular intensity of markings, in some of its forms closely approaching the Australian *C. chimerinana*, Meyr.

Probably everywhere abundant; occurs at Hamilton, Wellington, Christchurch, Akaroa, and Dunedin, either in bush, on open grassy places, or on coast sandhills, from November to April. I have also found worn specimens in August, probably hybernated.

3. Pyrgotis, Meyr.

Thorax crested. Antennæ in male ciliated. Palpi moderate, porrected, second joint triangularly scaled. Forewings in male with strong costal fold. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 stalked, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 separate at origin, 5 closely approximated to 4 at base, 6 and 7 stalked.

Separated from *Capua* by the distinct origin of veins 3 and 4 of the hindwings, and from *Adoxophyes* by the thoracic crest. There are two New Zealand species, besides which there is only one other known, from Australia.

3. *Pyrg. plagiatana*, Walk.

(*Conchylis plagiatana*, Walk., Brit. Mus. Cat., 370, (*Pyrgotis*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 441; *Conchylis recusana*, Walk., Brit. Mus. Cat., 371; *Grapholitha punana*, Feld., Reis. Nov., pl. CXXXVII, 43; ? *G. xylinana*, ibid., 44.)

Minor, alis ant. ochreo-albidis, ochreo-strigulatis, fascia angusta angulata prope basim, altera obliqua ante medium, tertia a costa ante apicem in alteram inferius percurrente, maculaque marginis postici inferiori ochreo-fuscis, triangulo costæ medio incluso pallidiore; post. albidis, apice leviter ochreo.

Male, female.—15–19 mm. Head and thorax whitish-ochreous. Forewings triangular, costa slightly arched, apex produced, hindmargin sinuate, oblique; whitish, more or less suffused with pale ochreous-yellowish, and coarsely strigulated with darker ochreous; markings ochreous-fuscous or dark fuscous, irregularly variable in intensity; a sharply angulated fascia near base, upper half often nearly obsolete; inner margin sometimes suffused with dark fuscous; central fascia straight, narrow, from ⅓ of costa to ⅔ of inner margin; an inwardly oblique narrow streak from costa before apex, dilated and enclosing a pale spot on costa, uniting with central fascia near inner margin, so as to enclose a large pale costal triangle, sometimes white; a large irregular roundish blotch on lower half of hindmargin, sometimes confluent above with the streak from costa; a subapical streak

before hindmargin : cilia pale ochreous, with a darker line near base, tips at apex blackish. Hindwings whitish, at apex ochreous-tinged, coarsely spotted with grey ; cilia whitish.

Variable in intensity of colouring, the female apparently darker than the male ; easily known from the next species by its larger size and much lighter ground-colour.

Larva moderate, cylindrical, slightly tapering at each end ; pale whitish-grey-greenish, becoming darker smoky-grey on back ; head and plate of second segment, when young, black, when full-grown greenish-ochreous. Feeds between joined leaves of oak (*Quercus robur*), gnawing numerous holes, and forming a loose silken gallery for shelter. Pupa in a thin silken cocoon in same position. I found these larvæ plentiful in April, and bred a female indoors in June. The food-plant being imported, the larva is probaby polyphagous.

Common at Dunedin, Christchurch, and Wellington, probably very generally distributed ; in January, and again in April and May.

4. *Pyrg. zygiana*, n. sp.

Minor, alis ant. brunneis, plumbeo-strigulatis, partim nigro-suffusis, striga obscura albida posteriori in apicem percurrente ; post. griseis.

Male, 14 mm.—Head, palpi, and thorax reddish-fuscous mixed with dark fuscous. Antennæ grey, annulated with blackish. Abdomen grey. Legs grey-whitish, anterior and middle tibiæ and tarsi and apical joints of posterior tarsi suffused with dark fuscous, except at apex of joints. Forewings moderate, posteriorly dilated, costa moderately arched, hindmargin sinuate, oblique ; rather dark reddish-ochreous-fuscous, mixed with dark fuscous, and coarsely strigulated throughout with leaden-grey ; costa and inner margin shortly strigulated with blackish ; an indistinct blackish suffusion in disc near base, and another in disc towards apex ; an indistinct slender streak of grey-whitish scales from near inner margin before anal angle to apex, where it is suffusedly dilated : cilia reddish-fuscous mixed with dark fuscous. Hindwings grey ; cilia whitish-grey, with two indistinct darker lines.

Differing widely from the preceding in the fuscous ground-colour, leaden strigulations, grey hindwings, and small size.

One specimen taken amongst bush near Christchurch in March.

4. ADOXOPHYES, Meyr.

Thorax smooth. Antennæ in male ciliated. Palpi moderate or rather long, porrected, second joint triangularly scaled. Forewings in male with strong costal fold. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 stalked, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 separate at origin, 5 approximated to 4 at base, 6 and 7 stalked.

Differs from *Pyrgotis* in the absence of the thoracic crest. Of the three known species, one is Australian, and the other two belong to New Zealand, not closely approaching the Australian species. In all the sexes differ more or less conspicuously.

5. *Adox. lotinana*, n. sp.

Media, alis ant. dilute ochreis, costæ dimidio anteriori dorsoque anguste fuscis, margine postico late fusco-suffuso, plumbeo-strigulato, fascia media perobliqua fusca dimidium non superante, ciliis albis; post. griseis.

Male, 17 mm.; *female*, 21 mm.—Head and thorax light ochreous. Palpi elongate, light ochreous, externally suffused with dark fuscous. Antennæ light ochreous, sharply annulated with dark fuscous. Abdomen whitish-ochreous. Legs whitish-ochreous, anterior and middle tibiæ and tarsi suffused with dark fuscous, except at apex of joints. Forewings moderate, in male triangular, in female more oblong, costa gently arched, hindmargin straight, rather oblique, rounded beneath; light ochreous; inner margin and anterior half of costa narrow suffused with dark fuscous, mixed with reddish-fuscous; hindmargin broadly suffused with reddish-fuscous, indistinctly strigulated with leaden-grey, the veins remaining pale-ochreous: posterior half of costa strigulated with dark fuscous; a very oblique moderately broad ill-defined reddish-fuscous streak from costa before middle, hardly reaching half across wing: cilia white, with a dark fuscous basal line. Hindwings grey, lighter in female; cilia whitish, with a grey basal line.

Separable from the next species by the darker hindwings, almost wholly white cilia of forewings, and larger size.

The larva feeds on *Arundo conspicua* ("toi grass"), but I do not know in what manner. Mr. R. W. Fereday informs me that he bred the species from conspicuous firm white cocoons, attached openly to the surface of the leaves.

Mr. Fereday obtained several specimens in this manner near Christchurch, and I am indebted to him for my types.

6. *Adox. conditana*, Walk.

(*Teras conditana*, Walk., Brit. Mus. Cat., 306; *Pandemis gavisana*, ibid., 312; *Conchylis marginana*, ibid., 371; ? *Rhacodia rureana*, Feld., Reis. Nov., pl. CXXXVII., 47; *Teras flavescens*, Butl., Proc. Z. L. S., 1877, 402; *Pyrgotis porphyreana*, Meyr., Proc. Linn. Soc. N.S.W., 1881, 443; *Capua aoristana*, ibid., 446.

Minor, alis ant. dilute vel saturate ochreis griseisve, interdum fusco-suffusis, linea transversa angulata prope basim, fascia media obliqua, maculaque costali saturatioribus, ciliorum dimidio basali nigrescente; post. M. griseis, F. albis.

Male, 12–15 mm ; *female*, 15–16 mm.—Head, palpi, and thorax in male whitish-ochreous, ochreous, fuscous, or grey, in female whitish-ochreous ; palpi elongate. Antennæ whitish-ochreous or greyish, in male sharply annulated with dark fuscous. Abdomen whitish-ochreous or grey. Legs varying from whitish to dark fuscous. Forewings in male triangular, moderate, costa moderately arched, somewhat bent in middle, hindmargin almost straight, rather oblique ; in female rather oblong, dilated posteriorly, costa strongly arched towards base, sinuate beyond middle, apex somewhat produced, hindmargin somewhat sinuate, rather oblique ; in male pale whitish-ochreous, whitish-grey, ochreous, fuscous, or dark fuscous-grey, more or less distinctly strigulated or reticulated with darker ; in female whitish-ochreous, reticulated with darker ochreous ; one whitish-grey male has posterior half of wing reddish-fuscous, and one grey male has whole wing except basal patch suffused with blackish-grey ; outer edge of basal patch, central fascia, and costal spot generally ochreous-fuscous or fuscous, more or less distinctly darker than ground-colour, but sometimes wholly obsolete in male ; outer edge of basal patch in male from $\frac{1}{4}$ of costa to $\frac{1}{4}$ of inner margin, sharply angulated above middle, in female irregular, from $\frac{1}{4}$ of costa obliquely outwards, angulated above middle, thence irregularly concave, ending in middle of inner margin ; central fascia rather narrow, straight, from middle of costa to inner margin before anal angle, generally obsolete beneath, posterior edge dilated outwards into an abrupt suffused projection above middle ; costal spot in male roundish, sometimes produced as a fascia to anal angle, in female flattened semi-oval, often confluent with projection of central fascia ; costal space between central fascia and costal spot often conspicuously paler than ground-colour : cilia in male whitish or whitish-ochreous, basal half blackish-grey, sometimes almost wholly blackish-grey, in female whitish-ochreous, towards base dark ochreous-fuscous. Hindwings in male varying from grey-whitish to dark grey, when light spotted with darker, cilia paler, with a darker basal line ; in female white, apex very faintly ochreous-tinged, cilia white.

The variability of this species is extraordinary, the sexes being also very different, and the various forms can hardly be included in a single description. From the preceding species the female is immediately distinguishable by the white hindwings and different form, the male by the conspicuous dark basal half of the cilia of forewings, the usually perceptible basal patch and costal spot, and the much smaller size.

Larva moderate, cylindrical, slightly tapering at both ends ; pale greyish-green, spots concolorous ; head pale greyish-ochreous, lateral margins dark fuscous, mouth spotted with dark fuscous ; second segment greenish-whitish, with an ochreous-tinged dorsal plate ; anal segment greenish-whitish, with a

small ochreous-tinged plate. Feeds in a light silken tube amongst spun-together leaves of *Genista* in garden hedges. Pupa in a thin firm white silken cocoon in same place. Probably the larva is polyphagous, the food-plant not being native.

Occurs commonly at Christchurch, Nelson, Dunedin, Wellington, and Auckland, in January, and again in March and April; during the latter months I also found the larvæ feeding, from which imagos emerged in April. The species flies abundantly over its food-plant for a short time about sunset, and I have also taken it at light. It is to be regretted that I should have fallen into the error of adding to the already too numerous synonyms of the species, misled by its extreme variability. I was also wrong in imagining the existence of a thoracic crest, often a difficult character to observe; the species is therefore not referable to *Pyrgotis*.

5. Proselena, Meyr.

Thorax smooth. Antennæ in male shortly ciliated. Palpi moderate, porrected, second joint triangularly scaled. Forewings in male with costa simple. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 separate at origin, 5 parallel or approximated at base to 4, 6 and 7 stalked.

Differs from the preceding genera by the separation of veins 7 and 8 of the forewings, from *Harmologa* by the absence of the costal fold, from *Tortrix* by the separation of veins 3 and 4 of the hindwings. I have thought it best to widen the original definition of this genus, (founded on a single species), by not insisting on the parallelism of veins 3, 4, 5 of the hindwings; these differ much in relative direction, but the differences are probably incapable of definition, and insufficient for generic distinction. As thus established the genus includes two described Australian species, (I have a third unpublished), and three are now added to it from New Zealand, of which number one was formerly erroneously referred to *Tortrix*.

These three species may be thus tabulated:—

A. Forewings whitish-grey	7. *aspistana*.
B. ,, ochreous.	
1. Forewings unicolorous	9. *siriana*.
2. ,, with basal third much paler than remainder	8. *hemionana*.

7. *Pros. aspistana*, n. sp.

Parva, alis ant. albido-griseis, macula basali trianguloque costæ magno castaneis, fusco-marginatis; post. griseis.

Male.—13 mm. Head, palpi, and thorax whitish-grey, somewhat mixed with fuscous (but damaged). Antennæ whitish-grey (?). Abdomen whitish-grey. Legs whitish-grey, anterior and middle pair suffused with dark fuscous except at apex of joints. Forewings oblong, rather narrow,

slightly dilated posteriorly, costa moderately arched near base, thence nearly straight, somewhat sinuate beyond middle, hindmargin rather strongly oblique, nearly straight, very slightly sinuate; whitish-grey, with some scattered spots of dark fuscous scales; basal patch reddish-brown, exterior edge sharply marked, broadly dark fuscous, from $\frac{1}{5}$ of costa to $\frac{1}{5}$ of inner margin, irregular, hardly angulated; a large reddish-brown triangular costal patch, extending on costa from $\frac{1}{3}$ to near apex, reaching rather more than half across wing, apex broken and partially suffused, anterior and posterior edges sharply marked, broadly margined with dark fuscous, costal edge marked with three small dark fuscous spots; a similar small dark fuscous spot on costa before apex: cilia grey-whitish, with a dark grey basal line. Hindwings grey, with a pencil of long whitish-yellowish hairs on costa at base; cilia pale grey.

Immediately known by the whitish-grey forewings, with reddish-brown basal and costal patches.

Two specimens, in poor condition, taken by Mr. J. D. Enys, at Porter's Pass.

8. *Pros. hemionana*, n. sp.

Parva, alis ant. dilute ochreis, plusquam dimidio posteriore post-lineam obliquam fusco, antice saturatiore; post. griseis.

Male.—12½–13½ mm. Head, palpi, and thorax whitish-ochreous; palpi rather elongate, externally fuscous. Antennæ whitish-ochreous, annulated with dark fuscous. Abdomen light grey. Legs grey-whitish, anterior and middle pair suffused with dark fuscous except at apex of joints. Forewings moderate, posteriorly somewhat dilated, costa rather strongly arched near base, thence nearly straight, hindmargin nearly straight, oblique; pale whitish-ochreous, with scattered obscure ochreous-fuscous strigulæ; base indistinctly suffused with ochreous-brownish; posterior $\frac{3}{5}$, beyond a straight sharply-defined line from $\frac{2}{5}$ of costa to slightly beyond middle of inner margin, fuscous, strigulated with dark reddish-fuscous, and becoming dark fuscous towards anterior edge, more broadly towards costa, and on a small very ill-defined costal spot towards apex: cilia whitish-ochreous or light brownish-ochreous, with a broad dark fuscous basal line. Hindwings grey; cilia grey-whitish, with a darker basal line.

Rendered conspicuous by the contrast of the pale basal and dark posterior areas.

Six specimens taken by Mr. R. W. Fereday near Lake Guyon in March.

9. *Pros. siriana*, Meyr.

(*Tortrix siriana*, Meyr., Proc. Linn. Soc. N.S.W., 1881, 521.)

Parva, alis ant. M. ochreo-brunneis, fusco-sparsis, F. saturate ochreis, puncto disci nigro; post. M. nigrescentibus, F. albidis.

Male, 10½–12 mm.; *female*, 14 mm.—Head and thorax in male deep brownish-ochreous, in female reddish-ochreous. Forewings narrow, costa moderately arched, hindmargin almost straight, rather strongly oblique; in male deep brownish-ochreous, mixed with dark fuscous, especially posteriorly, in female reddish-ochreous, with a few dark fuscous scales; a tolerably distinct dark fuscous dot in disc beyond middle: cilia ochreous, towards anal angle in male greyish, in female whitish. Hindwings and cilia in male blackish, in female whitish.

Markedly distinct by its unicolorous forewings, and the strongly-contrasted hindwings.

Taken in plenty in January amongst long grass near Hamilton, on the skirts of the forest. This, as well as the other species, appears to be very local.

6. Harmologa, n. g.

Thorax smooth or rarely crested. Antennæ in male ciliated. Palpi moderate or rather long, porrected, second joint triangularly scaled. Forewings in male with strong costal fold. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 separate at origin, 5 approximated at base to 4, 6 and 7 stalked or separate.

Separated from *Proselena* by the costal fold, from *Cacoecia* by the separation of veins 3 and 4 of hindwings. To this genus belong some of the species formerly referred provisionally to *Cacoecia*; I have at present five New Zealand species, but have not observed the genus as occurring elsewhere. These species, which are very various in superficial appearance, may be separated as follows:—

A. Forewings whitish in ground-colour.
  1. Hindwings ochreous-whitish .. .. 14. *amplexana.*
  2. ,, grey .. .. 10. *sisyrana.*
B. Forewings fuscous or grey.
  1. Hindwings ferruginous-yellow or whitish-yellow .. .. .. 13. *ænea.*
  2. ,, grey.
    a. Forewings with a whitish hind-marginal blotch.. .. .. 12. *zatrophana.*
    b. ,, without whitish blotch.. .. .. 11. *oblongana.*

10. *Harm. sisyrana*, n. sp.

Media, alis ant. dilute griseis, nigro-strigulatis, area basali obscura, fascia media obliqua, maculisque costæ posterioribus quatuor parvis saturatioribus; post. griseis.

Male, 17½ mm; *female*, 20 mm.—Head, palpi, and thorax grey-whitish, mixed with fuscous-grey and blackish; palpi rather short; thorax crested. Antennæ grey. Abdomen whitish-grey. Legs grey-whitish, anterior and middle tibiæ and all tarsi suffusedly banded with dark fuscous. Forewings

moderate, in female more elongate, costa moderately arched, hindmargin obliquely rounded, in female very faintly sinuate; whitish, mixed with grey, with fine scattered irregular blackish strigulæ throughout; basal patch greyer, ill-defined, outer edge irregularly angulated in middle, marked by a somewhat stronger black strigula; central fascia moderate, ill-defined, fuscous-grey, running from before middle of costa to $\frac{2}{3}$ of inner margin, edges very irregular, anterior edge rather deeply emarginate above and below middle, towards inner margin partially obsolete; four small subquadrate fuscous-grey spots on costa towards apex, in female giving rise to confused very irregularly reticulated fuscous-grey lines proceeding obliquely to hindmargin: cilia grey-whitish, basal third within a dark grey line whitish barred with dark grey. Hindwings grey, paler in female, spotted with darker; cilia whitish, with a grey basal line.

This species appears to be the only one with a crested thorax, but it does not seem necessary at present to separate it on that account; it cannot be confused with any other.

A pair taken on sandhills near Christchurch, in March; I have seen several others from the same locality, taken in November and December.

11. *Harm. oblongana*, Walk.

(*Teras oblongana*, Walk., Brit. Mus. Cat., 303, (*Cacoecia*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 489; *Teras inaptana*, Walk., Brit. Mus. Cat., 304; *Teras cuneigera*, Butl., Cist. Ent., II., 559.)

Minor, alis ant. griseis, interdum ochreo-suffusis, area basali, fascia media abbreviata cum macula costæ triangulari confluente, macula anguli analis, alteraque marginis postici parva saturatioribus, striga disci nigra; post. griseis.

Male, female.—15–19 mm. Head and thorax greyish-fuscous or grey; palpi rather elongate. Forewings moderately broad, posteriorly dilated in male, costa moderately arched, hindmargin sinuate, slightly or not oblique; grey or ochreous-grey, with indistinct darker strigulæ; basal patch somewhat darker, outer edge marked by a dark strigula, very irregularly angulated above middle; central fascia moderate, varying from grey to dark reddish-fuscous, running from before middle of costa to $\frac{2}{3}$ of inner margin, generally obsolete on lower half, anterior edge well-defined on upper half, posterior edge suffused; an ill-defined grey or fuscous-grey blotch on costa about $\frac{2}{3}$, often uniting with upper half of central fascia to form a large triangular blotch; often a slender blackish longitudinal line in disc on central fascia, and in female the central fascia sometimes mixed with brownish-ochreous, especially above this line; a very indistinct blotch on anal angle, sometimes confluent with the costal blotch; a small dark spot on hind

margin above middle: cilia grey or greyish-ochreous, with a darker line. Hindwings light grey, sometimes partially ochreous-tinged, spotted and often suffused with darker grey; cilia whitish-grey, with a darker basal line.

Rather variable in colour and considerably in intensity of marking; but easily separated from all the other species of the genus by its dull grey hue.

Occurs rather commonly at Christchurch, Dunedin and Blenheim, in December, January and March, seeming attached to *Leptospermum*. Butler's *cuneigera* is founded on a light-coloured specimen with strongly-marked costal blotch, received from Blenheim; I have seen two similar specimens from the same locality, but can find no reliable point of distinction and have no doubt of their identity.

12. *Harm. zatrophana*, n. sp.

Minor, alis ant. rufis, griseo-mixtis, macula magna posteriori albida ochreo-mixta; post. saturate griseis.

Female.—14 mm. Head, palpi and thorax reddish-ochreous-brown, mixed with whitish-grey; palpi moderate, grey-whitish internally and beneath. Antennæ grey, annulated with black. Abdomen dark grey. Legs grey, anterior and middle tibiæ and all tarsi suffused with dark fuscous, except at apex of joints. Forewings rather narrow, oblong, costa gently arched, apex nearly rectangular, hindmargin sinuate, not oblique; reddish-ochreous-brown, thickly mixed with dark fuscous-grey; a tolerably well-defined large whitish blotch on hindmargin, almost reaching costa and anal angle, extending in disc to $\frac{2}{3}$ from base, containing two small pale ochreous spots mixed with grey scales, one on its upper and the other on its lower margin, almost uniting in middle, so as to bisect the blotch: cilia reddish-ochreous-brown mixed with grey. Hindwings dark grey, apex blackish-grey; cilia whitish-grey, with a dark grey basal line.

Very distinct by its deep colouring and the posterior whitish blotch.

One fine specimen taken at light at Christchurch in March. The male being unknown, the generic location is not absolutely assured, but I have little doubt the species is correctly placed.

13. *Harm. ænea*, Butl.

(*Teras ænea*, Butl., Proc. Z.L.S., 1877, 402.)

Major, alis ant. fuscis, M. flavo, F. ochreo-suffusis, costa F. alba; post. M. saturate flavis, posterius nigro-mixtis, F. albis, posterius dilute flavis.

Male, 27 mm.; *female*, 30 mm.—Head, palpi and thorax in male brownish-ochreous mixed with fuscous, in female ochreous-whitish suffused with pale ochreous; palpi rather long. Antennæ in male fuscous, in female whitish-ochreous. Abdomen in male yellowish-ochreous mixed with fuscous, in female ochreous-whitish. Legs ochreous-whitish, anterior and middle pair more or less suffused with fuscous-grey, posterior tibiæ in male

suffused with yellowish. Forewings oblong, hardly dilated, in male moderately broad, in female narrower, costa moderately arched, hindmargin not oblique, in male gently rounded, in female sinuate beneath apex; dull greyish-fuscous, irregularly suffused in male with golden-ochreous-yellow, in female with light yellowish-ochreous; in male extreme costal edge whitish except near base, in female costa narrowly white throughout: cilia in male ochreous-grey-whitish, basal half suffused with yellowish, in female white, base ochreous-tinged. Hindwings in male deep ferruginous-yellow mixed with dark grey, especially posteriorly, so as sometimes to form a broad dark hindmarginal band, and an obscure discal spot beyond middle, costa towards middle broadly paler, cilia whitish-yellow, at base and on anal angle ferruginous-yellow; in female dull white, becoming broadly pale yellow posteriorly, cilia white, at base pale yellow.

Conspicuous by its large size and distinctly coloured hindwings.

Common at Porter's Pass and Mount Hutt, in January, but probably confined to the mountain districts. I owe my specimens to the kindness of Mr. J. D. Enys, who also furnished Butler's original type.

14. *Harm. amplexana*, Z.

(*Idiographis (?) amplexana*, Z., z.b.V., 1875, 222, (*Cacoecia*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 494; *Cacoecia vilis*, Butl., Proc, Z.S.L., 1877, 402, pl. XLIII., 15.)

Minor, alis ant. albidis, angulo revolucrum amplectente, fascia media obliqua, M. superius obsoleta, maculaque costæ triangulari saturate fuscis; post. albidis, apicem versus leviter ochreis.

Male, female.—15–17 mm. Head and thorax whitish; palpi elongate, externally mixed with dark fuscous. Forewings moderate, oblong, hardly dilated, costa in male slightly arched, bent before middle, in female strongly arched towards base, slightly sinuate beyond middle, hindmargin not oblique, rather strongly sinuate beneath apex; whitish, indistinctly strigulated with fuscous; basal patch represented in male by a sharply-marked blackish-fuscous narrow fascia proceeding from costa at $\frac{1}{4}$ obliquely inwards to disc, thence abruptly to base beneath costa, in female by a dark fuscous fascia from costa before $\frac{1}{5}$, irregularly angulated below costa, bent inwards in disc as in male, but less defined; central fascia rather narrow, dark fuscous, from costa before middle to inner margin beyond middle, in male obsolete towards costa, in female distinct throughout, anterior edge dark-margined, posterior edge suffused; a rather ill-defined fuscous triangular patch extending on costa from middle to before apex, its lower extremity usually connected with central fascia and anal angle by two irregularly curved cloudy lines; a cloudy fuscous spot on middle of hindmargin, its anterior edge marked with from two to four blackish dots; hindmargin sometimes dotted with black: cilia grey-whitish, becoming dark fuscous

towards base, especially round apex. Hindwings whitish, faintly yellowish-tinged posteriorly, and spotted with grey; cilia whitish, with a grey basal line.

Remote from all its congeners in superficial appearance; the peculiar angulated subcostal mark at base, (differing in the sexes), is unique in its way, but only conspicuous in the male.

Common at Christchurch, Wellington, and Dunedin, generally in gardens, in January, February, March, and August.

7. Cacoecia, Hb.

Thorax smooth. Antennæ in male ciliated. Palpi moderate or rather long, porrected, second joint triangularly scaled. Forewings in male with strong costal fold. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 from a point, 5 approximated at base to 4, 6 and 7 separate (rarely stalked).

Distinguished from *Harmologa* by the origin of veins 3 and 4 of the hindwings from the same point, from *Tortrix* by the costal fold of male. Of the species which I originally referred here, four have been satisfactorily determined to be mere varieties, three have been transferred to the neighbouring *Harmologa*, one (of which the male had been unknown) to *Tortrix*, and one is removed to the *Grapholithidæ*, the basal pectination of the hindwings having been overlooked. I have now only two true species of *Cacoecia* from New Zealand; the genus is numerously represented in Australia.

15. *Cac. excessana*, Walk.

(*Teras excessana*, Walk., Brit. Mus. Cat., 303, (*Cacoecia*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 491; *Teras biguttana*, Walk., Brit. Mus. Cat., 305; *Tortrix taipana*, Feld., Reis. Nov., pl. CXXXVII., 46; *Cacoecia inana*, Butl., Proc. Z. S. L., 1877, 403, pl. XLIII., 13.)

Media, alis ant. ochreis fuscisve, interdum purpureo-suffusis, area basali, fascia media obliqua inferius dilatata, macula costæ triangulari alteraque marginis postici parva vix saturatioribus, sæpe obsoletis; post. albido-griseis.

Var. *a*. Alis ant. macula disci ante medium parva albida.

Male, female.—19–28 mm. Head and thorax varying from ochreous to dark fuscous or purple-fuscous (sometimes discolorous); palpi rather long. Forewings moderately broad, posteriorly dilated, less in female, costa moderately arched, in female straighter posteriorly, hindmargin sinuate, not oblique; varying from ochreous to dark ochreous-fuscous, finely strigulated with darker, sometimes wholly suffused with purple; markings very ill-defined, hardly darker than ground-colour, often wholly obsolete; outer

edge of basal patch strongly angulated above middle, beneath connected with a spot on inner margin before middle; central fascia from before middle of costa to inner margin at $\frac{3}{4}$, narrow above, strongly dilated on lower half, margins very irregular; a triangular patch on costa about $\frac{3}{4}$; a small spot before middle of hindmargin (sometimes conspicuously darker): cilia ochreous or ochreous-fuscous, with a darker basal line. Hindwings whitish-grey or almost whitish, more or less spotted with darker grey, towards apex sometimes ochreous-tinged; cilia grey-whitish or ochreous-whitish, with two darker lines.

Var. *a*. Forewings with a small round whitish or whitish-ochreous spot in disc between basal patch and central fascia.

A very variable species, but always characterized by extreme indefiniteness of marking, and broader-winged than the following. The var. *a* (described by Walker as distinct under the name of *biguttana*) I also supposed at first to be a good species, but have since seen transitional forms, which leave little doubt that it is merely a varietal development. The purple variety is also very striking and handsome.

Larva rather stout, cylindrical, somewhat tapering behind, with scattered short whitish hairs; whitish-green, spots hardly darker; dorsal very distinct, slender, dark green; head very pale greenish-ochreous. Feeds between joined leaves of *Panax arboreum (Araliaceæ)* in April; pupa free in same position. This larva produced a specimen of the purple variety in June (indoors). The larva is certainly not confined to this food-plant, and is probably more or less polyphagous.

Common at Auckland, Wellington, Nelson, Christchurch, and Dunedin, and probably generally, from January to May, and even in July.

16. *Cac. enoplana*, n. sp.

Media, alis ant. dilute fuscis, costa, linea antica transversa, fascia obliqua lata superius coarctata, trianguloque costæ saturate fuscis; post. albidis.

Male.—20 mm. Head, antennæ, thorax, abdomen, and legs whitish-brown; (palpi broken); anterior and middle tibiæ and tarsi suffused with dark fuscous except at apex of joints. Forewings moderate, posteriorly dilated, costa moderately arched, hindmargin sinuate, hardly oblique; light dull brown; costal edge and fold dark fuscous; outer edge of basal patch indicated by an irregular dark fuscous line from $\frac{1}{4}$ of costa to $\frac{1}{3}$ of inner margin; central fascia dark fuscous towards costa, towards inner margin hardly darker than ground-colour, but margined by dark fuscous lines, running from before middle of costa to before anal angle, very narrow on costa, gradually dilating to middle, very broad on lower half, margins rather irregular; a flattened-triangular dark fuscous spot on costa about $\frac{3}{4}$: cilia

light brown, with a darker basal line. Hindwings grey-whitish, very slightly ochreous-tinged, thinly spotted with grey; cilia whitish, spotted with grey at base.

Characterized by the clear well-defined markings; superficially rather resembling the Australian *C. mnemosynana*, Meyr., but removed from it by the strong costal fold.

One specimen taken at Wellington in February.

8. Tortrix, Tr.

Thorax smooth. Antennæ in male ciliated. Palpi moderate, porrected, second joint triangularly scaled. Forewings in male simple. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 from a point, 5 approximated at base to 4, 6 and 7 separate.

Separated from *Cacoecia* by the absence of costal fold in male, from *Proselena* by the origin of veins 3 and 4 of the hindwings from a point, from *Dipterina* by the simply and shortly ciliated antennæ of the male. Well represented in Australia; there are six known species from New Zealand, thus distinguishable:—

A. Head and thorax white	.. 17. *charactana.*
B. " " " grey	
1. Forewings moderately broad	.. 18. *demiana.*
2. " narrow	.. 22. *aërodana.*
C. Head and thorax ochreous	
1. Central fascia wholly absent	.. 21. *leucaniana.*
2. " " partly indicated or entire	
a. Posterior costal spot distinct	.. 20. *philopoana.*
b. " " " absent	.. 19. *pictoriana.*

17. *Tort. charactana*, Meyr.

(*Cacoecia charactana*, Meyr., Proc. Linn. Soc. N.S.W., 1881, 492.)

Minor, alis ant. albis, fasciæ mediæ dimidio superiore angusto nigrescente; post. albis, raro albido-griseis.

Male, female.—14–18½ mm. Head and thorax dull white; palpi rather elongate, externally mixed with dark fuscous. Forewings moderate, slightly dilated posteriorly, costa moderately arched towards base, thence nearly straight, faintly sinuate beyond middle, hindmargin slightly sinuate, not oblique; dull white, faintly strigulated with pale ochreous-grey, and with a few scattered blackish scales; outer edge of basal patch irregular, angulated above middle, partially indicated by blackish scales or obsolete; in female an indistinct grey spot on inner margin before middle, shading into edge of basal patch; central fascia from before middle of costa to inner margin before anal angle, upper third very narrow, blackish, or ochreous-fuscous mixed with black, lower two-thirds strongly and irregularly dilated, almost

wholly obsolete and faintly outlined; two or three small blackish dots before middle of hindmargin; sometimes a faint greyish triangular costal patch before apex, containing two or three blackish costal dots: cilia whitish, base dotted with black, on upper half dark fuscous towards base. Hindwings white (in one female whitish-grey), spotted with grey; cilia white, base dotted with grey, round apex greyish.

Conspicuously distinct through the white ground-colour; in form of wing resembling a *Cacoecia*, but the male has not the slightest trace of a fold.

Originally described from one specimen taken near Auckland in January. I lately obtained five fine specimens near Christchurch in April, and have seen four others from the same place; the species is very distinct, and has no affinity with *obliquana*, Walk., as suggested.

18. *Tort. demiana*, n. sp.

Minor, alis ant. saturate griseo-fuscis, albido-irroratis; post. griseis.

Male.—17½ mm. Head, palpi, and thorax dark fuscous-grey, mixed with whitish-ochreous; palpi rather elongate, internally whitish-ochreous. Antennæ dark fuscous. Abdomen ochreous-grey, anal tuft pale greyish-ochreous. Legs ochreous-whitish, anterior and middle pair suffused with dark fuscous except at apex of joints. Forewings moderate, hardly dilated, costa moderately arched towards base, posteriorly nearly straight, hindmargin slightly sinuate, somewhat oblique; dark fuscous, densely mixed with whitish scales, and very obsoletely ochreous-tinged on small spots: cilia whitish mixed with dark fuscous. Hindwings fuscous-grey; cilia grey-whitish, with two very suffused fuscous-grey lines.

A very obscure-looking, yet very distinct species, in form approaching the preceding.

One fine specimen, kindly presented to me by Dr. W. H. Gaze, who took it near South Rakaia in March, amongst rough herbage.

19. *Tort. pictoriana*, Feld.

(*Grapholitha pictoriana*, Feld., Reis. Nov., pl. CXXXVII, 55.)

Media, alis ant. ochreis, interdum fusco-suffusis, costa flava, triangulo ad basim magno saturate fusco vel etiam subviridi, fascia obliqua nigrescente, his sæpe obsoletis; post. albidis.

Male, female.—20–24 mm. Head, palpi, and thorax varying from pale ochreous to reddish-ochreous-brown; palpi moderate. Antennæ whitish-grey. Abdomen whitish-ochreous or whitish. Legs whitish, anterior pair suffused with dark fuscous except at apex of joints, middle tibiæ more or less suffused with reddish-fuscous. Forewings moderate, posteriorly rather dilated, narrowed towards base, costa gently arched, somewhat sinuate in middle, hindmargin indented beneath apex, not oblique; varying from very

pale whitish-ochreous to reddish-ochreous, sometimes finely strigulated posteriorly with dark fuscous; sometimes wholly suffused, except towards costa, with smoky-grey or light greenish-grey; costal edge orange-yellow or ochreous-orange; basal patch represented by a large triangular dark fuscous, dark reddish-fuscous, or sometimes dull green blotch, varying from very sharply defined to wholly obsolete, base near and parallel to inner margin, anterior side near and parallel to costa, posterior side outwardly oblique, anterior angle resting on base of wing, posterior angle connected with inner margin, apex confluent with central fascia; central fascia moderate or rather narrow, nearly evenly broad, margins slightly irregular, running from before middle of costa to $\frac{2}{3}$ of inner margin, blackish-fuscous or dark reddish-fuscous, sharply defined throughout, or partially or wholly obsolete except anterior edge towards inner margin: cilia whitish-ochreous, with an ochreous-orange basal line, tips becoming dark fuscous round apex. Hindwings whitish, slightly tinged with greyish towards base and with reddish-ochreous posteriorly, spotted with grey; in male with a pencil of long whitish hairs at base of costa; cilia white.

A handsome and exceedingly variable species, very distinct from any other. The pencil of hairs in the male is similar to that of *Pros. aspistana*, but I attach no generic importance to this character.

An autumnal insect, occurring commonly at Porter's Pass, Lake Guyon, South Rakaia, and Christchurch, in March and April.

20. *Tort. philopoana*, Meyr.

(*Tortrix philopoana*, Meyr., Proc. Linn. Soc. N.S.W., 1881, 515.)

Minor, alis ant. dilute ochreis, area basali, fascia obliqua inferius dilatata, trianguloque costæ posticæ parvo ochreo-fuscis; post. M. albido-griseis, F. albis.

Male, female.—14–17 mm. Head and thorax pale ochreous; palpi moderate. Forewings moderate, in female more elongate and narrower, costa moderately arched, hindmargin slightly sinuate, oblique, in female more oblique; pale ochreous, with a few scattered blackish scales; basal patch ochreous-fuscous, rather ill-defined, especially in female, outer edge from $\frac{1}{5}$ of costa to $\frac{1}{4}$ of inner margin, angulated above middle; central fascia ochreous-fuscous, from before middle of costa to anal angle, narrow towards costa, lower $\frac{2}{3}$ rather dilated, margins slightly irregular, generally with a blackish dot on posterior margin below middle; a rather small triangular ochreous-fuscous spot on costa midway between central fascia and apex; sometimes a small ill-defined ochreous-fuscous spot on middle of hindmargin; markings in female usually more reddish-ochreous and less well-defined: cilia whitish-ochreous. Hindwings whitish-grey, in female often whitish; cilia whitish, with a faint grey basal line.

Allied to the Australian *T. glaphyrana*, Meyr., but not to be confused with any other New Zealand species.

Taken abundantly at Hamilton amongst long grass on the skirts of the forest, in January.

21. *Tort. leucaniana*, Walk.

(*Conchylis leucaniana*, Walk., Brit. Mus. Cat., 370, (*Tortrix*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 517; *Gelechia intactella*, Walk., Brit. Mus. Cat., 652; *Teras pauculana*, ibid., Suppl., 1781.)

Minor, alis ant. dilute ochreis, squamis paucis conspersis punctoque disci nigris, sæpius striga disci brevi longitudinali grisea; post. albis.

Male, female.—14–18 mm. Head and thorax pale ochreous; palpi moderate. Forewings moderate, in female more elongate and narrower, costa moderately arched, hindmargin slightly sinuate, oblique, in female more oblique; pale ochreous, sometimes deeper in female, often rather darker between the veins posteriorly; some irregularly scattered blackish scales; generally a rather more conspicuous black dot in disc beyond middle, usually preceded by a short longitudinal cloudy greyish streak above middle: cilia whitish-ochreous. Hindwings white, posteriorly sometimes faintly greyish; cilia white.

Allied to the preceding, which it resembles in form of wing, but entirely devoid of the usual transverse markings.

Very common and widely distributed, occurring in grassy places at Auckland, Hamilton, Cambridge, Wellington, Nelson, and Christchurch, in January, February, September, and October.

22. *Tort. aërodana*, Meyr.

(*Tortrix aërodana*, Meyr., Proc. Linn. Soc. N.S.W., 1881, 520.)

Parva, alis ant. griseis, albido nigroque conspersis, M. interdum fascia angusta obliqua maculaque costæ ochreis; post. M. saturate griseis, F. albidis.

Male—10–11 mm.; *female*—14–14½ mm. Head and thorax grey; palpi moderate. Forewings narrow, costa moderately arched, hindmargin slightly rounded, very oblique; rather dark grey, irrorated with grey-whitish, and with scattered blackish scales, in female paler; in male sometimes a distinct slender ochreous fascia from before middle of costa to before anal angle, and an ochreous costal spot, but these are often imperceptible: cilia grey-whitish, darker towards base. Hindwings in male dark grey, in female whitish, posteriorly whitish-grey; cilia in male grey, in female whitish, with a darker basal line.

Immediately known by its small size, grey colouring, and narrow wings.

Eight specimens taken amongst heathy scrub at Hamilton in January.

9. Dipterina, Meyr.

Thorax generally with a very small crest, or smooth. Antennæ in male biciliated with fine long cilia. Palpi moderate, porrected, second joint triangularly scaled. Forewings with costa simple in male. Hindwings not broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 from a point, 5 slightly (or rarely strongly) approximated at base to 4, 6 and 7 stalked (rarely separate).

Distinguished from *Tortrix* by the long fine biciliations of the antennæ, and usually by the stalking of veins 6 and 7 of the hindwings. There are several Australian species. Of the three given hereafter, *D. imbriferana* is a typical species of the genus. *D. incessana* differs in some respects, having veins 6 and 7 of hindwings separate, and more elongate palpi, for which reasons I formerly referred it to *Arotrophora*, but it is without the characteristic antennal dentations of that genus, and the antennæ appear here to furnish the most reliable characters. *D. jactatana* also diverges in respect of the separation of veins 6 and 7 of hindwings, and in having vein 5 closely approximated to 4 at base; acquaintance with the male shows its former conjectural position to have been erroneous. The three species are very dissimilar and easily distinguished:—

A. Forewings whitish .. .. 25. *imbriferana.*
B. „ ochreous or fuscous.
  1. A sinuate black streak in disc .. .. 23. *jactatana.*
  2. No black streak .. .. 24. *incessana.*

23. *Dipt. jactatana*, Walk.

(*Batodes jactatana*, Walk., Brit. Mus. Cat., 317; *Sciaphila flexivittana*, ibid., 353; *Pædisca privatana*, ibid., 382; *Grapholitha voluta*, Feld., Reis. Nov., Pl. CXXXVII., 39.)

Minor, alis ant. ochreis, sæpe fusco-suffusis, postice fusco-maculatis, striga disci antica sinuata nigra; post. griseis.

Male, female.—18–19 mm. Head, palpi, antennæ, and thorax brownish-ochreous or fuscous; palpi rather elongate, externally dark fuscous. Abdomen ochreous-grey. Legs whitish-ochreous, anterior and middle pair suffused with dark fuscous, except towards apex of joints. Forewings moderate, somewhat dilated posteriorly, costa moderately arched, hindmargin slightly sinuate, not oblique; varying from light brownish-ochreous to fuscous, paler towards anterior half of costa; a sinuate blackish streak in disc, reaching from near base to middle, anterior extremity obscurely bent downwards to inner margin; five or six small dark fuscous spots on costa, the two last coalescing below costa; a small dark fuscous spot in disc beyond middle, another on middle of hindmargin, and a third on anal angle; all these spots obsolete in darker specimens: cilia light ochreous, with a fuscous line near base. Hindwings grey; cilia whitish-grey, with a grey basal line.

Peculiarly characterized by the strong sinuate black discal streak.

Three specimens taken near Dunedin.

24. *Dipt. incessana*, Walk.

(*Teras incessana*, Walk., Brit. Mus. Cat., 304, (*Arotrophora*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 529.)

Minor, alis ant. fuscis, fascia media directa, macula costæ triangulari, alteraque anguli analis angusta erecta saturatioribus; post. griseis.

Male, female.—13–16 mm. Head and thorax dark fuscous; palpi rather long. Forewings moderately broad, subtriangular, costa moderately arched, hindmargin sinuate, oblique; dull reddish-fuscous, strigulated with darker, with dark reddish-fuscous markings; outer edge of basal patch indicated by an indistinct rather irregular line; central fascia moderately broad, not oblique, from middle of costa to middle of inner margin, anterior edge straight, well-defined, posterior edge suffused, connected with a cloudy spot in disc beyond middle; a triangular spot on costa at ¾; a short erect streak from anal angle, reaching nearly half across wing: cilia pale reddish-fuscous, with a strong blackish basal line. Hindwings grey, indistinctly spotted with darker; cilia pale grey, with a darker basal line.

Considerably broader-winged than the following species, and widely distinct by the fuscous colouring and straight perpendicular central fascia.

I took one specimen at Auckland in January; Mr. R. W. Fereday has two others, taken at Christchurch in November and December.

25. *Dipt. imbriferana*, Meyr.

(*Dipterina imbriferana*, Meyr., Proc. Linn. Soc. N.S.W., 1881, 527.)

Parva, alis ant. albidis, area basali, fascia media angulata, macula costæ, alteraque anguli analis griseis; post. griseis.

Male, female.—9½–12 mm. Head and thorax whitish; palpi moderate. Forewings rather narrow, not dilated, costa moderately arched, hindmargin obliquely rounded; whitish, sometimes faintly clouded with grey, obscurely strigulated with fuscous-grey; basal patch more or less fuscous-grey, outer edge irregularly angulated in middle; central fascia suffusedly fuscous-grey, obscurely margined with dark-fuscous, moderate, rather narrower towards costa, running from middle of costa to middle of inner margin, angulated in middle; apical portion of wing more distinctly strigulated with fuscous-grey, strigulæ generally coalescing to form a spot on costa at ¾, a smaller spot on anal angle, and sometimes one on middle of hindmargin: cilia whitish, with a grey basal line. Hindwings grey, darker posteriorly; cilia grey, with a darker basal line.

An inconspicuous species, yet not like any other.

Taken at Auckland and Wellington in January.

10. Eurythecta, n. g.

Thorax smooth. Antennæ in male shortly ciliated. Palpi moderate, porrected, second joint triangularly scaled. Forewings with costa simple in male. Hindwings broader than forewings, cilia long. Forewings with 10 separate veins, vein 6 to costa, (normal veins 3 and 4, 7 and 8 being probably coincident). Hindwings with 7 veins, 2, 3, 4 remote at origin, short and nearly parallel, 5 and 6 rising near together, 7 free, cell long, transverse vein bent, rather outwardly oblique, (normal veins 3 and 4 coincident).

The only known genus of the group possessing only 10 veins in the forewings; and the venation of the hindwings is also peculiar. The type does not, however, appear ancestral, but rather as an eccentric development from *Tortrix*.

26. *Eur. robusta*, Butl.

(*Zelotherses robusta*, Butl., Proc. Z.S.L., 1877, 403, Pl. XLIII., 17; *Steganoptycha negligens*, ibid., 404, Pl. XLIII., 18.)

Parva, alis ant. albis, ochreis, vel rufis, fasciis duabus obliquis perfractis, maculis costæ marginisque postici septem nigrescentibus; post. griseis.

Male, female.—9½–10 mm. Head white, often suffused with ochreous or reddish-ochreous, face and a longitudinal line on crown generally remaining white. Palpi white, externally generally suffused with ochreous. Thorax varying from white to reddish-ochreous, back sometimes dark fuscous. Antennæ grey. Abdomen elongate, stout, whitish-grey or whitish. Legs white, anterior and middle pair suffused with dark fuscous except at apex of joints. Forewings very narrow, costa in male almost straight, in female slightly arched, hindmargin very oblique, nearly straight; white, grey-whitish, ochreous, or reddish-ochreous-brown, the white specimens often partially suffused with pale ochreous; markings sharply defined, dark fuscous or blackish; a narrow very oblique fascia from near base of costa to inner margin before middle, rather widely interrupted immediately below costa, broadly dilated towards inner margin; a moderate oblique fascia from before middle of costa to inner margin at ⅔, evenly broad, generally interrupted beneath costa, margins sometimes irregular; three small subquadrate equidistant inwardly oblique spots on costa between central fascia and apex, often separated by white scales, a fourth at apex, and three others on hindmargin: cilia whitish, whitish-ochreous, or grey, base barred with black and white. Hindwings fuscous-grey, darker posteriorly, thinly scaled towards base; cilia whitish or grey, with a darker basal line.

A rather handsome and very distinctly marked species, extremely variable in colour.

Mr. R. W. Fereday formerly took this species in abundance amongst grass near Christchurch, whence it seems now to have disappeared, probably owing to the extermination of native by English grasses.

11. PROTHELYMNA, n. g.

Thorax smooth. Antennæ in male biciliated with fascicles of long fine ciliations. Palpi moderate, porrected, second joint roughly scaled above and beneath. Forewings with costa simple in male. Hindwings as broad as forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 widely remote at origin, nearly parallel, 5 slightly approximated to 4 at base, 6 and 7 long-stalked, transverse vein very oblique.

Differs from *Proselena* especially by the peculiar ciliations of the antennæ. An interesting genus, approaching more nearly to the common ancestral type of the *Tortricina*, than any other native to New Zealand. It has considerable affinity both with *Proselena* and *Dipterina*, the very oblique transverse vein of the hindwings being found in some species of both those genera (as *Pros. annosana* and *Dipt. imbriferana*).

27. *Proth. nephelotana*, n. sp.

Minor, alis ant. dilute griseo-ochreis, fusco-nebulosis, area basali fasciaque media subobliqua obsoletis vix saturatioribus ; post. dilute griseis.

Male.—18 mm. Head, palpi, and thorax brownish-ochreous sprinkled with dark fuscous. Antennæ grey. Abdomen whitish-grey-ochreous. Legs whitish, anterior and middle pair suffused with dark fuscous except at apex of joints. Forewings moderate, costa moderately and evenly arched, hindmargin obliquely rounded ; pale greyish-ochreous, mixed with fuscous, and strigulated with dark fuscous ; basal patch and central fascia fuscous, more ochreous towards disc, very ill-defined ; outer edge of basal patch nearly straight, rather oblique ; inner edge of central fascia running from before middle of costa to middle of inner margin, rather irregular, outer edge wholly suffused and obsolete ; a longitudinal slender blackish line in central fascia below middle, above which is an ochreous patch ; faint traces of a cloudy fuscous costal spot about $\frac{3}{4}$: cilia ochreous-whitish, with an indistinct grey line near base. Hindwings rather light grey, apex darker ; cilia whitish, with traces of two grey lines.

A very obscurely marked insect, yet very different in appearance from any other.

One fine specimen taken amongst bush near Christchurch in March.

Fam. 2. GRAPHOLITHIDÆ.

Lower median vein of hindwings pectinated with hairs towards base ; vein 2 of forewings rising before posterior third of lower margin of cell.

The genera occurring in New Zealand may be thus tabulated :—

I. Forewings with 12 veins.
- A. Veins 3 and 4 of hindwings from a point.
  - 1. Thorax crested .. .. 12. *Epalxiphora.*
  - 2. " smooth.
    - a. Forewings in male with costal fold .. .. .. 14. *Pædisca.*
    - b. " " " simple .. .. 13. *Aphelia.*
- B. Veins 3 and 4 of hindwings stalked or coincident.
  - 1. Forewings in male with costal fold.
    - a. Antennæ of male notched above basal joint .. .. 17. *Strepsiceros.*
    - b. " " " entire .. .. 16. *Protithona.*
  - 2. Forewings in male simple.
    - a. Hindwings in male with discal groove and ridge near base .. .. 15. *Carpocapsa.*
    - b. " " " simple .. .. 19. *Exoria.*

II. Forewings with 11 veins. .. .. 18. *Hendecasticha.*

12. Epalxiphora, Meyr.

Thorax with a very large erect crest on each side of back, and a small double crest behind. Antennæ in male thinly ciliated. Palpi moderate, straight, porrected, second joint with appressed scales. Forewings with costa in male simple, apex falcate. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 from a point, 5 moderately approximated to 4 at base, 6 and 7 stalked.

A very peculiar genus, remote from any other known to me; it contains only one species.

28. *Epalx. axenana*, Meyr.

(*Epalxiphora axenana*, Meyr., Proc. Linn. Soc. N.S.W., 1881, 648.)

Media, alis ant. ochreo-albidis, dilute rufo-nebulosis, fascia angusta dentata antica, duabus aliis ad costam confluentibus, signo disci trirami, macula costæ triangulari, strigaque postica sinuata saturate rufis; post. griseo-albidis.

Male.—26 mm. Head and thorax whitish-ochreous, mixed with ochreous and dark fuscous. Forewings oblong, moderately broad, costa rather strongly arched, dilated before middle, apex falcate, hindmargin obliquely sinuate; whitish-ochreous, irregularly mixed and clouded with brownish-ochreous; veins posteriorly slenderly dark fuscous; markings ochreous-fuscous, becoming darker reddish-fuscous on costa and inner margin; outer edge of basal patch represented by a slender irregular, twice deeply dentate, fascia from $\frac{1}{5}$ of costa to $\frac{2}{5}$ of inner margin; margins of central fascia represented by similar slender irregular fasciæ, both starting together from $\frac{2}{5}$ of costa, separating immediately below costa, anterior one proceeding nearly directly to inner margin beyond middle, posterior one sharply angulated

below middle, terminating immediately before anal angle; an elongate spot in middle of disc, interrupting anterior edge of central fascia, its upper edge emitting a sharp inwardly oblique tooth in middle; a very flattened-triangular spot on costa, extending from near middle to a little before apex; a sinuate longitudinal streak before middle of hindmargin: cilia ochreous-white, with a dark fuscous basal line, and barred with reddish-fuscous. Hindwings whitish, posteriorly suffusedly mottled with grey; cilia white, with a basal row of grey spots.

A curious and rather elegant species, perhaps of South American affinity.

I took one specimen at rest on a tree-trunk at Wellington in January, and Mr. R. W. Fereday has a second from the same locality, taken in February.

13. APHELIA, Stph.

Thorax smooth. Antennæ in male shortly ciliated. Palpi moderate or elongate, porrected, roughly scaled. Forewings with costa simple in male. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 from a point, 5 very closely approximated to 4 at base, 6 and 7 stalked.

This genus cannot be considered truly indigenous to New Zealand, but I am not aware whether it could have been artificially introduced. The larva is believed to feed in the stems of *Juncus*, but is hardly known. The species here described is now cosmopolitan in range.

29. Aph. *lanceolana*, Hb.

Minor, alis ant. ochreis fuscisve, sæpius vitta media saturate fusca, interdum perfracta vel obsoleta; post. griseo-albidis.

Male, female.—14–20 mm. Head and thorax varying from whitish-ochreous to ochreous-brown; palpi variable in length, sometimes very long. Forewings narrow, not dilated, costa gently arched, hindmargin nearly straight, oblique; pale ochreous, often suffused with fuscous, sometimes wholly fuscous mixed with reddish-ochreous; costa generally with numerous very fine oblique darker strigulæ; sometimes a straight ill-defined dark fuscous central streak from base to apex, entire or interrupted so as to form two or three irregular spots, or visible at apex only, or wholly absent: cilia varying from whitish-ochreous to fuscous. Hindwings grey-whitish, apex sometimes darker; cilia grey-whitish, sometimes with a darker line.

Very variable, some of the varieties tending to be localized.

Taken near Hamilton in January.

14. PÆDISCA, Ld.

Thorax smooth. Antennæ in male shortly ciliated. Palpi moderate, porrected, second joint roughly scaled. Forewings with strong costal fold

in male. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 from a point, 5 approximated to 4 at base, 6 and 7 separate or stalked.

This genus belongs to a group very extensively represented in the northern hemisphere, but practically absent from Australia. The single New Zealand species stands quite alone; I at first erroneously referred it to *Cacoecia*, which it closely resembles in most respects, but the basal pectination, which I had overlooked, is strongly marked, and I have now no doubt of its true position.

30. *Ped. obliquana*, Walk.

(*Teras obliquana*, Walk., Brit. Mus. Cat., 302; *Teras spurcatana*, ibid., 305, (*Cacoecia*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 487; *Sciaphila transtrigana*, Walk., Brit. Mus. Cat., 354; *Sciaphila turbulentana*, ibid., 355; *Teras cuneiferana*, ibid., Suppl., 1780; *Tortrix ropeana*, Feld., Reis. Nov., pl. CXXXVII., 45; *Tortrix herana*, ibid., 52; ? *Teras congestana*, Walk., Brit. Mus. Cat., 308.)

Media, alis ant. griseo-ochreis albidisve, fusco-strigulatis vel suffusis, linea angulata prope basim, fasciæ obliquæ marginibus ac parte superiore, macula costæ alteraque marginis postici saturate fuscis; post. griseo-albidis.

Male, female.—16–22 mm. Head and thorax pale ochreous or almost whitish, often suffused with fuscous; palpi elongate. Forewings moderately broad, in male posteriorly dilated, costa moderately arched, hindmargin sinuate, not oblique; pale greyish-ochreous or sometimes whitish, generally strigulated, and more or less irregularly suffused with fuscous or dark fuscous, sometimes wholly fuscous; costa shortly strigulated with dark fuscous; markings fuscous or dark fuscous, darkest in the paler specimens, nearly obsolete in the darker; outer edge of basal patch indicated by a darker line, sharply angulated above middle, lower $\frac{2}{3}$ in male thick, generally conspicuously blackish-fuscous; central fascia from before middle of costa to before anal angle, costal third generally conspicuously darker fuscous or blackish-fuscous, moderate in male, very narrow in female, lower two-thirds strongly dilated, not darker than ground-colour except on edges, anterior edge more distinct, very irregular, posterior edge angulated near inner margin; a very ill-defined triangular costal spot about $\frac{3}{4}$, and a small spot towards middle of hindmargin, often connected by an oblique strigula; the large triangular space between basal patch and central fascia in male often conspicuously paler than rest of wing: cilia whitish-ochreous, with a fuscous-grey basal line. Hindwings grey-whitish or light grey, spotted with grey; cilia whitish, with two grey lines.

An exceedingly variable species, but always dull-coloured; some varieties of the female in colour and form approach the female of *Cacoecia excessana*, and are only separated with ease by the family characters.

Larva rather stout, cylindrical, attenuated at both ends; rather light dull green, bluish-tinged towards back, yellowish-tinged on sides and on segmental divisions; spots hardly lighter; head (when full-grown) pale dull ochreous, spotted with brownish-ochreous on crown. When younger (until last moult), head small, black, deeply incised behind, second segment greenish-whitish, transparent, hindmargin and posterior angles suffused with blackish. Feeds amongst spun-together shoots and leaves of *Veronica*, *Lonicera*, *Rumex*, etc.; probably very polyphagous. Pupa in same position, without cocoon. Larvæ were found plentifully in February and March, from which moths emerged in April, but probably they are feeding during most of the year. The species is very liable to the attacks of a large solitary dipterous parasite, which destroys nine-tenths of the larvæ.

Very common, and probably universally distributed, occurring at Auckland, Hamilton, Wellington, Christchurch and Dunedin, from November to April, and occasionally in June and July.

15. CARPOCAPSA, Tr.

Thorax smooth. Antennæ in male simple. Palpi moderate, ascending, appressed to face, second joint shortly rough-scaled beneath. Forewings with costa simple in male. Hindwings broader than forewings, in male with a short membranous ridge on lower median near base, and a grooved channel below it. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 stalked, 5 nearly parallel to 4, 6 and 7 separate,

Very distinct from any indigenous genus; represented only by one species, imported from Europe with the apple tree, on the fruit of which the larva feeds.

31. *Carp. pomonella*, L.

Minor, alis ant. griseis, strigulis transversis saturatioribus, macula magna postica fusco-cuprea, metallico-cincta, antice nigro-marginata; post. fuscis.

Male, female.—16–18 mm. Head and thorax dark fuscous-grey, sprinkled with whitish. Forewings moderate, posteriorly dilated, costa hardly arched, hindmargin oblique, sinuate; ashy-grey (scales dark grey with white tips), with numerous irregular transverse greyish-fuscous lines, coalescing to form a rather narrow transverse band at $\frac{1}{3}$ from base; a moderately broad elongate-ovate coppery-fuscous patch on anal angle, extending along hindmargin nearly to apex, preceded and followed by a metallic line, and containing two small metallic spots on anal angle; the anterior metallic line is preceded by a blackish streak, extending from inner margin half across wing: cilia grey, rather metallic, paler towards

base, with a strong blackish line. Hindwings fuscous-grey, apex rather darker; cilia grey-whitish, with a dark fuscous line near base; discal groove in male furnished with a pencil of hairs.

The hindmarginal coppery patch makes this species immediately recognizable.

Taken at Wellington, but probably widely spread, though hitherto little noticed.

16. PROTITHONA, n. g.

Thorax smooth. Antennæ in male shortly ciliated. Palpi moderate, porrected, second joint roughly scaled. Forewings with strong costal fold in male. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 7 veins (normal veins 3 and 4 coincident), 4 somewhat approximated to 3 at base, 5 and 6 separate.

Intermediate between *Holocola* and *Strepsiceros*, agreeing with the former in the entire antennæ of male, with the latter in the separation of veins 7 and 8 of the forewings, in other characters harmonizing with both. The single species has the superficial appearance of a small *Holocola*.

32. *Prot. fugitivana*, n. sp.

Minima, alis ant. griseo-ochreis, macula disci, duabus etiam dorsi divergentibus nigris, spatio intermedio ochreo-albido; post. griseis.

Male.—8 mm. Head, palpi, thorax, and abdomen pale greyish-ochreous, mixed with fuscous. Antennæ dark fuscous. Legs whitish-grey-ochreous, anterior and middle tibiæ and all tarsi suffused with dark fuscous, except at apex of joints. Forewings narrow, costa moderately arched, hindmargin very obliquely rounded; light greyish-ochreous; a suffused elongate blackish patch in disc above middle; an inwardly oblique suffused blackish mark on inner margin before middle, before which the ground-colour is somewhat mixed with blackish; an outwardly oblique slightly curved broad blackish spot from inner margin before anal angle, extending suffusedly to apex; the space between these three blackish marks is ochreous-whitish, which colour is suffusedly produced along submedian fold to base; three small suffused dark fuscous spots on costa towards apex: cilia ochreous-whitish, mixed with dark fuscous towards base. Hindwings fuscous-grey; cilia ochreous-grey-whitish.

One of the smallest and most insignificant-looking of the *Tortricina*, in markings somewhat recalling *Hol. thalassinana*, Meyr.

One specimen taken near Lake Coleridge in March.

17. STREPSICEROS, Meyr.

Thorax smooth. Antennæ in male ciliated, with an excavated notch a little above basal joint. Palpi moderate, porrected, second joint roughly

haired, sometimes tufted beneath. Forewings with strong costal fold in male. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins (or 7 by coincidence of 3 and 4), 3 and 4 long-stalked or coincident, 5 closely approximated at base to 4, 6 and 7 separate.

A characteristic Australian genus; both the New Zealand species are found in Australia, whence it seems probable they may have been introduced.

33. *Streps. ejectana*, Walk.

(*Sciaphila ejectana*, Walk., Brit. Mus. Cat., 350, (*Strepsiceros*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 681; ? *Sciaphila absconditana*, Walk., Brit. Mus. Cat., 351; *Sciaphila servilisana*, ibid., 356; *Sciaphila saxana*, ibid., 357; *Conchylis ligniferana*, ibid., 363.)

Minor, alis ant. griseis, albido-sparsis, vitta longitudinali post medium deflexa, trianguloque marginis postici saturatioribus, nigro ochreoque mixtis; post. saturate griseis.

Male, female.—12½–15 mm. Head and thorax grey mixed with ashy-whitish, shoulders ochreous-tinged. Antennæ of male notched at ⅕ from basal joint. Forewings moderate, slightly dilated posteriorly, costa gently arched, hindmargin nearly straight, oblique; light-grey, more or less sprinkled irregularly with whitish, and mixed with darker grey, disc in female sometimes longitudinally whitish; costa strigulated with blackish; in male a tuft of raised scales on submedian fold before middle; a cloudy irregular somewhat sinuate broad dark fuscous longitudinal streak in disc, mixed with ochreous and blackish, extending from near base to beyond middle, thence bent downwards to inner margin before anal angle; an ill-defined triangular dark fuscous blotch on upper half of hindmargin, sometimes ochreous-tinged, its apex extending inwards to disc at ¾, generally containing two or three longitudinal black streaks; in male these markings are lighter, less defined, and more or less obscured by a general grey mottling: cilia grey, mixed with whitish points, irregularly and indistinctly barred with blackish. Hindwings dark grey; cilia grey, with a dark-grey line near base; veins 3 and 4 long-stalked.

Easily known from the following by the broader wings, only partial coincidence of veins 3 and 4, and greater remoteness of the antennal notch from the basal joint; the markings are usually very different, but both species vary so much, and are sometimes so obscurely marked, that the structural points furnish the readiest means of distinction.

Larva active, cylindrical; dull green, more yellowish-tinged on sides and towards extremities, spots paler; head black; second segment, or posterior half only, black. Feeds in September in spun-together shoots, or in a loose tubular web amongst leaves, of *Leptospermum scoparium*: in Australia on other *Myrtaceæ*.

Common at Hamilton, Wellington, and Christchurch, in January and March.

34. *Streps. zopherana*, Meyr.

(*Strepsiceros zopherana*, Meyr., Proc. Linn. Soc. N.S.W., 1881, 688.)

Parva, alis ant. griseis, albido-sparsis, vitta subcostali nebulosa interrupta nivea, subtus partim nigro-marginata, macula parva supra angulum analem nigra; post. griseis.

Male, female.—11–12½ mm. Head and thorax grey irrorated with white, head sometimes almost wholly white. Antennæ of male notched at ⅛ from basal joint. Forewings very narrow, costa slightly arched, apex produced, hindmargin sinuate, very oblique; dark grey, irrorated with whitish, sometimes strigulated with dark fuscous; costa very obliquely strigulated with blackish-grey; a rather broad ill-defined white streak beneath costa from base to apex, crossed by an oblique dark grey fascia-like streak before middle, and three or four slender dark grey very oblique strigulæ between that and apex; middle of disc somewhat suffused with blackish; an ill-defined black spot above anal angle; a short black line bordering subcostal streak beneath towards apex; generally a row of about three ill-defined black dots above anal angle towards hindmargin, preceded and followed by an obscure silvery-metallic line: cilia dark grey, paler towards anal angle, with a blackish apical spot, costal cilia white. Hindwings thinly scaled, grey, darker at apex; cilia pale grey, with an indistinct darker line near base; veins 3 and 4 coincident.

Variable in distinctness and intensity of marking.

Generally abundant amongst *Leptospermum scoparium*, on which the larva doubtless feeds; at Hamilton, Wellington, Christchurch, and Dunedin, in August, September, January, and March.

18. Hendecasticha, Meyr.

Thorax smooth. Antennæ in male ciliated, with an excavated notch near base. Palpi moderate, porrected, second joint densely rough-haired above and below. Forewings with strong costal fold in male. Hindwings broader than forewings. Forewings with 11 separate veins (normal veins 7 and 8 probably coincident), 7 to costa. Hindwings with 7 veins (normal veins 3 and 4 coincident), 4 approximated to 3 at base, 5 and 6 stalked.

Nearly allied to *Strepsiceros*, but differing in only possessing 11 veins in the forewings. The genus contains only the one New Zealand species.

35. *Hend. æthaliana*, Meyr.

(*Hendecasticha æthaliana*, Meyr., Proc. Linn. Soc. N.S.W., 1881, 692.)

Parva, alis ant. saturate fuscis, strigulis transversis albidis obsoletis; post. saturate fuscis.

Male, female.—9–10½ mm. Head and thorax dark fuscous, sprinkled with ashy-whitish. Forewings narrow, costa hardly arched, hindmargin sinuate, very oblique; dark fuscous, irrorated with grey and ashy-whitish scales, especially on basal half and before apex, tending to form irregular transverse lines; sometimes an indistinct ochreous suffusion towards inner margin before middle, and above anal angle: cilia dark fuscous, extreme tips and base ashy-whitish. Hindwings dark fuscous; cilia dark fuscous, with a darker basal line.

Taken rather commonly amongst rough herbage near a swamp at Hamilton, in January.

19. EXORIA, n. g.

Thorax smooth. Antennæ in male ciliated. Palpi moderate, porrected, second joint roughly haired. Forewings with costa in male simple. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 7 veins (normal veins 3 and 4 coincident), 4 parallel to 3, 5 and 6 separate.

I cannot affirm for certain that this genus is correctly located; it is impossible to make out on the single specimen whether the lower median is truly pectinated or not, but in other respects it seems to have some affinity with the group of *Strepsiceros*, though the antennæ are not notched.

36. *Exor. mochlophorana*, n. sp.

Parva, alis ant. dilute griseo-ochreis, fascia antica subcurva, altera postica inferius dilatata, tertia subapicali, macula costæ media alteraque apicis saturate fuscis; post. griseis.

Male.—10½ mm. Head, thorax, and abdomen fuscous, mixed with pale greyish-ochreous. Palpi grey-whitish, externally suffused with fuscous. Antennæ dark fuscous. Legs dark fuscous, posterior tibiæ grey-whitish, apex of joints obscurely pale. Forewings very narrow, costa hardly arched, hindmargin nearly straight, extremely oblique; pale greyish-ochreous, obscurely strigulated with grey, and with scattered dark fuscous scales; base mixed with dark fuscous; two small dark fuscous spots on costa near base; a moderately broad slightly curved dark fuscous fascia from ⅓ of costa to ⅖ of inner margin; a small dark fuscous spot on middle of costa; a dark fuscous fascia from ⅗ of costa to anal angle, upper half narrow, lower half very broadly dilated; a narrow somewhat irregular dark fuscous fascia from ⅚ of costa to middle of hindmargin; a small dark fuscous apical spot: cilia ochreous-whitish mixed with grey. Hindwings rather dark grey; cilia grey, tips paler.

A very distinct species, in form and marking somewhat resembling *Eurythecta robusta*.

One fine specimen, kindly presented to me by Dr. W. H. Gaze, who informs me that he took it, with a second, at South Rakaia amongst rough herbage in March.

Fam. 3. CONCHYLIDÆ.

Lower median vein of hindwings without (rarely with) basal pectination; vein 2 of forewings rising from posterior fourth of lower margin of cell.

20. Heterocrossa, Meyr.

Thorax smooth. Antennæ in male with long fine cilia. Palpi moderate or long, second joint roughly haired above and towards apex beneath. Forewings with costa in male simple, surface with raised tufts of scales. Hindwings broader than forewings, lower median pectinated towards base. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 6 veins, 3 and 4 stalked from posterior angle of cell, 5 from upper angle of cell to slightly above apex, 6 free.

Remarkable as being the only known genus of the family possessing the basal pectination of the median vein, probably an ancestral character. The group to which it belongs, characterized by the peculiar neuration of the 6-veined hindwings, is almost confined to Australia.

37. *Het. adreptella*, Walk.

(*Gelechia adreptella*, Walk., Brit. Mus. Cat., 654, (*Paramorpha*) Meyr., Proc. Linn. Soc. N.S.W., 1881, 698.)

Minor, alis ant. griseo-ochreis, saturate griseo-sparsis, punctis plerisque, macula disci postica parva, serieque punctorum postica transversa nigris; post. albidis.

Male, female.—14–17 mm. Head and thorax grey, more or less irrorated with whitish; palpi in male moderate, in female very long, lower half dark fuscous; antennæ in male whitish-ochreous. Forewings very narrow, costa moderately arched, slightly bent before middle, hindmargin straight, very oblique; greyish-ochreous or grey, sometimes mixed with whitish, especially towards base of costa, and more or less densely irrorated with blackish-grey; costa with about seven small suffused blackish-grey spots; a suffused blackish-grey spot in disc at $\frac{3}{5}$ from base; between this and base are about eight black dots in upper half of wing, irregularly arranged, tending to be followed by raised scales; a large raised tuft on the discal spot, and another on submedian fold at $\frac{1}{3}$ from base; an angulated transverse row of blackish dots from $\frac{3}{4}$ of costa to anal angle; a hindmarginal row of similar dots: cilia dark grey, with whitish points. Hindwings whitish, apex sometimes greyish; cilia whitish.

Narrower-winged than the following, with dark grey and ochreous colouring, and otherwise very distinct.

Rather common amongst bush at Christchurch, and at Hamilton and Cambridge, in September, January, February, and March.

38. *Het. gonosemana*, Meyr.

(*Heterocrossa gonosemana*, Meyr., Proc. Linn. Soc. N.S.W., 1882.)

Minor, alis ant. albis, costæ basi, macula disci antica cum altera costæ pæne confluente, punctisque costæ quinque nigris, punctis disci quinque ochreis nigro-marginatis, serie punctorum postica transversa nigra; post. albidis.

Male, female.—17–19 mm. Head and thorax white; palpi in male moderate, in female elongate, lower half dark fuscous. Forewings narrow, costa gently arched, somewhat bent before middle, hindmargin straight, oblique; white, with scattered grey scales; a short thick black streak along base of costa, followed by a black dot; a small oblique blackish spot in disc at ⅓, preceded by a small fuscous-grey suffusion, and followed by two raised tufts, half black and half white; a small rather inwardly oblique blackish spot on costa at ⅓, almost connected with discal spot; these black markings are somewhat mixed on edges with whitish-ochreous; some raised scales towards inner margin at base and ⅓; five equidistant short blackish marks on costa between ⅓ and apex, rather oblique inwardly; five small spots of raised whitish-ochreous scales arranged in an oval in disc, each with a few black scales on margins; between these, and above posterior ones, is an ill-defined grey suffusion; a very ill-defined cloudy grey irregular dentate transverse line from second of the five costal marks to inner margin at ⅘, angulated above middle; a more distinct similar line from third costal mark to inner margin before anal angle, containing a series of blackish dots; a hindmarginal row of blackish dots: cilia white, mixed with grey. Hindwings and cilia whitish.

Three specimens taken at Dunedin in February.

The remaining descriptions of Walker, not quoted here, are all unidentifiable in themselves, and unrecognizable from the loss or original bad condition of the types. It is probable, however, that all are merely synonyms of species given above. A list of them is given in my paper cited above.

In the following indices the number refers to the number prefixed above to each genus and species. The names italicized are synonyms only:—

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ART. II.—*Further Additions to our Knowledge of the New Zealand* Crustacea.

By CHARLES CHILTON, M.A.

[*Read before the Philosophical Institute of Canterbury, 7th September*, 1882.]

Plates I.–III.

BRACHYURA.

Hymenosoma lacustris.

Elamena (?) *lacustris*, Chilton. (Trans. N.Z. Inst., vol. xiv., p. 172.)

THIS species was described from a single specimen, a female. I have since, through the kindness of Professor Hutton, received seven others, all males, so that I am now able to describe it more fully and to refer it to its proper genus.

In the Catalogue of the Stalk- and Sessile-eyed Crustacea of Australia Mr. Haswell has replaced the genera *Hymenicus* and *Halicarcinus* by Leach's original genus *Hymenosoma;* and my species will also come under this genus as it is defined in Mr. Haswell's catalogue. Its name will therefore be *Hymenosoma lacustris.*

Specific description :—Carapace nearly circular, rather broader than long; flat, naked, or with a few scattered hairs. Rostrum broad, strongly depressed, its upper surface concave from side to side, extremity in the form of an obtuse angle. Antero-lateral margins of the carapace with two obscure teeth. Chelæ of male small, propodos only slightly broader than the carpus, hairy. Ambulatory legs somewhat densely covered with long hairs, tarsi long, slender, compressed, densely-haired. Last pair of legs somewhat shorter than the preceding. Abdomen of male of five joints subequal in length, third rather narrower than the first and second, fourth nearly as wide as the third, last broadly rounded at the end; margin fringed with very short hairs, some longer ones being scattered on the surface. Abdomen of female with a slight median ridge along its whole length.

Hab. Lake Pupuke. (*Fresh water.*)

The hairs on the legs and carapace appear to be somewhat variable.

The third (external) maxillipedes are shown in pl. I., fig. 2 *a*. On them are found setæ of several kinds ranging from the ordinary plumose setæ (*c*) to others strongly serrated on each side (*b*).

This species is remarkably near *Hymenosoma australe*, Haswell, from Port Phillip. From this, however, it differs in the chelæ of the male which are small, while in *H. australe* they are " extremely large."

ISOPODA.

Genus **Scutuloidea**, (*novum*).

Generic description :—Body not very convex. Pereion much broader than the cephalon, increasing regularly in breadth up to the fourth segment and then decreasing again.

Pleon with last segment large and triangular, emarginate at apex. Last pair of pleopoda single-branched, consisting of a single broad squamiform plate.

This genus I have made for an Isopod of which I took several specimens at Timaru, and since then at Lyttelton Harbour. It will, I think, come nearest to *Cassidina*, Milne-Edwards; however, it does not resemble *C. typa* so much as it does *C. latistylis*, Dana,* the figure of which I have been able to see through the kindness of Professor J. von Haast. According to Mr. Miers, *C. latistylis* is the same as *C. emarginata*, Guérin-Ménev., and is found at Kerguelen's Island.†

From *Cassidina*, however, my genus differs in having the last pair of pleopoda unibranched. In *Cassidina* the outer branch is present, but is almost rudimentary, while the inner and basal one is large and broad; so that *Cassidina* appears to be truly intermediate between *Scutuloidea* and some genus such as *Zuzara*, which has the two branches equally developed.

Scutuloidea maculata, sp. nov. Pl. I., fig. 1.

Head moderately large, transverse, about twice as broad as long, produced obtusely between the bases of the antennæ. First thoracic leg short and stout, second long and slender, the rest more like the first though not quite so stout, all having the propodos ending in two strongly curved claws. Segments of pereion subequal in length. Pleon of two segments, last large, triangular, with a wide shallow notch at apex. Last pair of pleopoda each consisting of a single broad squamiform plate, more than twice as long as broad, narrowing posteriorly, the inner edge conterminous with the side of the last segment of the pleon, and reaching very nearly to the end of pleon.

Colour—pale yellowish-brown, whole body thickly covered with small purple spots.

Length about ⅛ of an inch.

Hab. Timaru, among seaweed at north side of the breakwater; Lyttelton Harbour.

Additional remarks on structure:—

The eyes are moderately large and placed wide apart at the posterolateral angles of the head.

The upper antenna (fig. 1*a*) is considerably shorter than the lower; the three joints of the peduncle decrease in size distally and pass insensibly into the flagellum, which consists of but few joints. On the distal portion of it "sensory setæ" are found. These at first appear to be egg-cup shaped bodies, having a stout base from which arises all round a curved portion forming the cup. But careful focussing will show that there is

* U.S. Exploring Expedition, 1852, XIV., Crustacea, part II., 784; pl. 52, fig. 12.

† Trans. Royal Society, vol. 168 (extra volume), p. 204.

another portion stretching out of the part already described, like a greatly elongated egg; this portion is exceedingly delicate and transparent; the small dot which marks the end of it is often more easily seen than the rest. (Fig. 1*b*.)

The mandible bears a three-jointed appendage; the first and second joints being equal in length and longer than the third; the last two bearing stout setæ which increase in length as they approach the distal ends of the joints on which they are situated (fig. 1*c*).

The first maxilla consists of two nearly straight lobes, the inner one tipped with slender plumose setæ, the outer one longer and larger and bearing strong serrated setæ at the extremity (fig. 1 *d*).

The second maxilla consists of three delicate overlapping plates; the two outer ones of which bear similar long simple setæ which appear to be transversely ribbed (fig. 1 *f*). On the third and inner lobe are setæ, two of which bear delicate filaments near the base only; the others bearing filaments on one side only throughout the whole length of the seta (fig. 1, *e*, *f*, *g*).

The maxillipedes have the basal portion long and straight, tipped at the end with several moderately strong setæ. This basal portion bears a four-jointed appendage, the joints of which decrease in size distally; the first three have the distal end produced into a rounded lobe tipped with setæ. (Fig. 1 *h*.)

The first pair of legs (fig. 1 *k*) is short and stout; the meros is short and expands greatly at the distal end, carpus very short, the dactylos is large and bears at the end two claws, the terminal one larger than the other which bears a small piece projecting on its inner side (fig. 1 *l*). The large claw appears to be more or less articulated to the rest of the dactylos. The second leg (fig. 1 *m*) is much longer and slenderer; the basos has its inner side fringed with short setæ, the meros is longer than in the first and expands distally, the carpus is slender and as long as the propodos; the dactylos ends with two claws (fig. 1 *n*), the smaller with several stiff projections along its inner edge, one towards the base of the claw being much stouter than the others. The remaining legs are somewhat like the first, though not so stout, being thus more or less intermediate in form between the first and the second.

The pleopoda or branchial plates have the basal joint broad and supporting two large branchial plates, the inner one being longer than the outer and broader at the base than at the end; both abundantly supplied with long plumose setæ (fig. 1 *o*). The pleopoda all rest in a cavity formed by the excavation of the under side of the segments of the pleon, much in the same way as in *Sphæroma*.

Genus **Anthura**, *Leach.*

(Bate's and Westwood's Brit. Sessile-eyed Crust., vol. ii., p. 157.)

Anthura affinis, sp. nov. Plate I., fig 4.

Segments of pereion subequal, cylindrical. Head somewhat shorter than the first segment of pereion. Antennæ short, not quite so long as the head; upper much smaller than the lower, consisting of four joints, of which the basal one is the largest, and a very small fifth joint bearing a small pencil of setæ; lower antennæ thick and strong, basal joint large, broad, with a groove above in which the upper antenna rests, the inner edge of this basal joint is straight and in close contact with that of the antenna on other side, along the median line; basal joint followed by three subequal joints, and a short, thick, rudimentary flagellum, the joints of which bear setæ thickly set on one side.

First pair of legs very strong, not reaching beyond the head; basos very thick distally, ischios also thick and strong, meros short, carpus subtriangular, produced along the side of the propodos, and bearing setæ on its distal extremity; propodos thick, ovate, in contact with both meros and carpus, palm short with a strong projection against which the dactylos impinges; dactylos short, strong, and curved. Remaining legs all similar, not subchelate, propodos longer than the carpus and meros together. First five segments of the pleon united so closely that the lines of suture cannot be distinguished, sixth segment distinct bearing biramous appendages; outer ramus of a single joint, half as long as the inner, semicylindrical surrounding the inner ramus, its upper inner edge serrate and fringed with long setæ very delicately plumose; inner ramus of two joints equal in length and breadth, broad, edges fringed with long setæ; telson broad, round at end, with several long setæ near the centre.

Colour—pale yellow with blotches of black on the head, segments of pereion, pleon and telson. Length about $\frac{1}{8}$ of an inch.

Hab. Lyttelton Harbour. Found on seaweed at low tide.

This species is a true *Anthura*, coming apparently near to *A. gracilis*, from which however it is sufficiently distinct.

The first pair of legs only are chelate, all the rest are simple; they have the dactylos large and strong, the end forming a claw distinct from the basal portion; at the base of this claw three or four simple setæ arise laterally, and a short stout one on the inside. There is also a short stout seta on the inner distal angle of the propodos (pl. I., fig. 4 *c* and *d*).

The pleopoda are of the usual form, having a short basal joint bearing two equal oval plates with the distal margins setose. Each of these branchial plates is slightly constricted on each side, half way between the two

CRUSTACEA.

C.C. del.

ends. The first pair of pleopoda are modified so as to form an operculum covering the others; one of the plates, the outer I think, is long and broad so that it extends along the whole of the under side of the pleon; the inner plate appears to perform no special function, it is small and narrow, apparently becoming rudimentary (fig. 4 *f*). The setæ on the pleopoda are long and fringed on each side with long plumes, which are exceedingly delicate.

Cubaris rugulosus, Miers. (Cat. Stalk- and Sessile-eyed Crustacea of N.Z., p. 96.)

This species was described by Mr. Miers from specimens in the collections of the British Museum. His specimens appear to have been imperfect, for he neither describes nor figures the antennæ. I have found it abundantly at Eyreton, and also in the bush at Oxford. The inner antennæ are very small and composed of three joints, the basal one stout, second short and narrowing distally, third about twice as long as the second, much narrower, with a few short setæ at the end (pl. I., fig. 3 *a*). The outer antennæ consist of seven joints. The basal one is short, the second and third subequal and rather shorter than the fourth; the fifth joint is the longest, and is longer than the flagellum, which consists of two joints, the first short, very slightly longer than broad, the second more than three times as long as the first and followed by a minute terminal joint which bears two or three short setæ; the whole antenna, but more especially the distal portion, is finely hirsute, the hairs being short and delicate, much more so than can be shown in the figure (pl. I., fig. 3 *b*).

In describing the last segment of the abdomen, Mr. Miers says: "terminal segment much the broadest at the base, with the sides at first converging and then parallel." In my specimens the sides after converging usually diverge slightly.

The colour varies considerably. It is usually yellowish-brown with darker patches, but some specimens are uniformly black.

Over the whole body the integument is covered with peculiar scale-like markings, each scale being usually more or less pointed at the end (pl. I, fig. 3 *c*).

Philongria rosea, Koch. (Bate's and Westwood's Brit. Sessile-eyed Crust., vol. ii., p. 460.)

In a previous paper I have identified specimens found at Christchurch and Eyreton as this species, and at the same time adduced reasons for believing that it could not well have been introduced from Europe. Since then I have found specimens precisely similar in the bush at Oxford, so that I think there can be little doubt that it is really a native of New Zealand and has not been introduced.

I find that my specimens differ from those described by Messrs. Bate and Westwood in one small point, which I had previously overlooked. In theirs the upper surface of the body "is tuberculated, each tubercle emitting a minute seta at its top." In my specimens the tubercles are not very well marked, and the setæ, though certainly very small, are perhaps rather too large to be called minute, as compared with the animal itself.

I do not, however, consider this difference sufficient to warrant its removal from the European species.

Genus **Plakarthrium,** (*novum*).

Body much depressed, almost flat. Both antennæ having some of the basal joints expanded, flat; outer antenna with a flagellum. Coxæ very largely developed. Last pair of pleopoda biramous, lamellar.

Plakarthrium typicum, sp. nov. Plate I., fig. 5.

First two joints of inner antenna much expanded, first sub-rectangular, second sub-triangular, bearing on its posterior border the third joint, which is small and not expanded and is followed by a very small joint bearing two or three auditory cilia. Outer antenna with peduncle of five joints; the first two small and cylindrical, the third expanded, triangular, fourth expanded, transverse, fifth cylindrical, followed by a slender many-jointed flagellum reaching to the posterior border of the third thoracic segment. Eyes small, placed in the centres of the two rounded lateral portions of the head. Head transverse, about twice as broad as long, entirely enclosed by the expanded joints of the antennæ and by the coxæ of the first thoracic segment. Thoracic segments sub-equal in length, the central ones being rather broader than the first and the last. Coxæ very large, lamellar, more than half as broad as their segments; coxa of last thoracic segment reaching nearly to the extremity of the last pair of pleopoda. First two pairs of legs slender, three following pairs short and stout, last two pairs slender, similar to the first two, all ending in strong curved claws. Abdomen sub-rectangular, showing indications of three segments, the last larger than the first two together; posterior border concave. Last pair of pleopoda apparently arising right at the posterior end of the abdomen, basal joint short, flat, about as long as broad, inner branch oblong, inner margin straight, outer branch broader, expanding distally.

Colour—light-reddish brown, with a few small scattered dots of a darker brown. Length about $\frac{1}{8}$ of an inch.

Hab. Lyttelton Harbour. On stems of a brown seaweed, probably *Ecklonia radiata.*

I do not know where this peculiar Isopod should be placed. In some respects it is like *Amphoroidea*, but it differs very greatly from it in others. As yet I have only found it on one kind of seaweed, probably *Ecklonia*

radiata. It affords a very good example of protective resemblance, for the body being very flat and of a brown colour can scarcely be distinguished from the seaweed, to which it closely adheres. It has several appliances which enable it to cling tightly to the seaweed; in the first place all the legs are furnished at the ends with powerful hooked claws, then on the under side of the basal joint of last pair of pleopoda and round the proximal edge of the outer branch are strong hooked setæ, and besides this, on the basal joints of all the legs, on some parts of the under surface of the head and in one or two other places, are small projections of the integument which may possibly be hooked setæ, though their nature is not very apparent, but which certainly appear to have the same function. They are shown on the basal joints of the legs in fig. 5 *d* and *f*.

In the mouth parts the maxillipedes appear to have the same form as in *Sphæroma*, etc., consisting of a long slender basal portion bearing an appendage of four joints, none of which is produced into a lobe at the distal end. The maxillæ I have not made out satisfactorily. The mandible is long and slender and has a sharp cutting edge of four teeth, and below two setæ with stout bases. There is no appendage unless a rounded protuberance on the mandible itself is to be regarded as such (fig. 5 *c*).

The branchial plates—pleopoda—rest in a slight hollow formed by the arching of the abdomen. There appear to be two distinct kinds, the first (fig. 5 *g*) consists of a short basal joint bearing two long subequal joints, each of which bears several long plumose setæ; in the second (fig. 5 *h*) the basal joint is about twice as broad as long, the inner branch is short and triangular, the inner edge straight and the outer one slightly curved, it has no setæ except a few exceedingly delicate ones along the inner edge; the outer branch is of the same length as the inner, and is curved so as to fit along the curved outer edge of the inner branch, it bears short plumose setæ along its outer edge, these start about half-way along the joint, and are at first very small, but gradually increase in size till the end where they are largest.

When viewed from above the last pair of pleopoda appears to be articulated on to the abdomen at its posterior edge, but when seen from below it will be found that the basal joint extends anteriorly along the under side of the abdomen, and no doubt belongs as usual to the sixth segment of pleon, which is, together with the others, completely united to the terminal one or telson.

At the end of the abdomen, in the centre, there is a small opening formed by the posterior edge of the abdomen being slightly arched and thus raised a little above the inner branch of the last pleopod; at this opening is a kind of strainer formed by setæ on the posterior edge of the abdomen and

on the inner anterior angle of the inner joint of the last pair of pleopoda. Its function, doubtless, is to admit water to the branchial plates, and at the same time to prevent the ingress of sand or other extraneous matter, the flow of water is no doubt kept up by the movement of the branchial plates themselves.

All round the outer edge of the coxæ, the expanded joints of the antennæ and the last pair of pleopoda, two distinct parallel borders are to be seen, the outer part of the integument being apparently produced beyond the inner and more opaque parts. From the inner line numerous short setæ arise, these seldom reach much beyond the outer line. (See figs. 5 *a*, *b*, *k*.)

Genus **Limnoria,** *Leach.*

(Bate's and Westwood's British Sessile-eyed Crustacea, vol. ii., p. 349.)

As this genus is new to New Zealand I quote here the generic characters.

"Oblong-ovate, depressed; antennæ subequal, cylindrical, not longer than the cephalon. Pereiopoda nearly alike, slender. Pleon six-jointed. Branchial plates naked. Terminal segment large, semicircular, with a lateral appendage on each side bearing two terminal slender styles."

Limnoria segnis, sp. nov. Pl. II., fig. 1.

Body covered with short setæ. Eyes large. Neither antenna longer than head, inner one stouter and longer than the outer, consisting of three joints, of which the second is the shortest, followed by a short flagellum of about three joints bearing setæ and long simple auditory cilia. Lower (outer) antennæ of four joints, the third and fourth subequal and longer than the first and second; followed by a short flagellum of three joints bearing simple setæ. Mandible strong, appendage small, apparently of only two joints, the last tipped with a few setæ. Maxillipedes similar to those of *L. lignorum*, but having the plate at base much longer, narrower at base than towards the distal end, extremity rounded, whole margin fringed with short setæ. Terminal segment of the tail entire rounded and flattened, without central dorsal carina and with the margins not raised. Last pleopoda with the inner branch strong, about twice as long as broad, the end and outer margin supplied with setæ about as long as the joint; outer branch small pointed at the end, and with two or three setæ on the outer edge near the end.

Length—$\frac{1}{8}$ of an inch.

Colour—white, opaque.

Hab. On seaweed, Lyttelton Harbour.

This species is very near *Limnoria lignorum*, the dreaded "Gribble" of Europe, but it differs in several small points already mentioned. It also differs in habits; *L. lignorum* burrows into the wood of piers, piles, etc.; but *L. segnis* I found on the roots of *Macrocystis*. It is very sluggish and

does not move when taken out of the water, even if it is touched, and a good deal of extraneous matter is usually found among the short setæ which cover the body.

AMPHIPODA.

Genus **Nicea.**

(Cat. Amphip. Crus. Brit. Mus., p. 51.)

Nicea egregia, sp. nov. Plate II., fig. 2.

Female.—Body much compressed dorsally; each segment of pereion raised into a crest which projects backwards over the succeeding segment; first three segments of pleon produced dorsally into crests rather more prominent than those on the segments of pereion. Crest of first segment of pleon extending along the dorsal surface of the cephalon and rising abruptly therefrom. Eye moderately large, round. Cephalon produced slightly upwards at the base of the upper antenna. Upper antenna shorter than the lower, peduncle of three joints nearly equal in length, decreasing slightly in size distally; flagellum about as long as the peduncle, each joint bearing long auditory cilia on its under side at the distal end. Peduncle of lower antenna with three joints visible, last two equal in length and considerably longer than the first, flagellum longer than the peduncle, setæ in short tufts at the end of each joint. First and second gnathopoda equal in size and similar in form; carpus long, sub-triangular, with setæ on its inner distal angle; propodos oblong not broader than carpus, palm slightly oblique, defined by a stout tooth, hairy. Coxæ about as deep as their respective segments. Pereiopoda subequal rather stout; meros expanded distally and produced anteriorly in the first two, posteriorly in the last three pereiopoda, each pereiopod with dactylos long strong and curved with a short seta arising on the inner margin towards the end. All the pereiopoda nearly free from setæ. Of the last three pairs of pleopoda, the first two reach to the same point slightly beyond the extremity of the body; the rami are about equal in length to the peduncles, and are provided with short strong teeth at the extremity and on their upper margins. Last pair of pleopoda apparently rudimentary, consisting of two joints rounded and perfectly free from setæ. Telson concave below, subrectangular, about as broad as long, rounded posteriorly, cleft about half-way down.

Male.—Differs in having the crests on segments of pereion not so prominent; first segment not produced so much along the head; *second gnathopod when fully developed chelate*, basos long and narrow, ischios and meros short, carpus apparently united with propodos, which is large and produced distally into a fixed finger against which the dactylos impinges, dactylos strong, rather blunt at end; the ends of both fingers setose. The first pair of gnathopoda same as those of female.

Colour—various, greater part of body usually tinged with red but sometimes with blue, integument thick and more or less opaque.

Length about ¼ inch.

Hab. Lyttelton Harbour. On seaweed, usually at roots of *Macrocystis.*

This species is very peculiar in appearance and presents several points of interest.

The maxillipedes are shown in Pl. II., fig. 2 *d*. Both the basos and ischios bear plates, that of the former ending in two rounded teeth, that of the latter rounded at the end and with its inner edge setose, the meros has its distal portion produced externally in a rounded lobe past the extremity of the carpus, the propodos has its distal and inner margins setose, the setæ on the inner margin being minutely serrate; the dactylos is broad, subtriangular, and nearly free from setæ.

The peculiar chelate character of the second pair of gnathopoda of male appears to be acquired only in fully-developed individuals; in smaller specimens they are subchelate, with the palm transverse, as shown in fig. 2 *g*; intermediate forms between this and the fully-developed form shown in fig. 2 *f* are also found. At first sight the carpus appears to be absent; I believe that it is joined on to the propodos, but the evidence of this is not quite satisfactory. The sixth segment of the pleon appears to be absent, unless the part that I have described as the basal portion of the last pair of pleopoda represents the sixth segment itself; if this be the case, the last pleopod will be represented only by a single rounded joint; in either case it certainly bears the appearance of being rudimentary and useless.

Genus **Montaguana.**

(*Montagua*, Spence Bate, Cat. Amphip. Crust. Brit. Mus., p. 54.)

As the name *Montagua* was long ago used by Fleming for a genus of Nudibranch Mollusca, I have altered the name of Mr. Spence Bate's genus to *Montaguana.*

Generic characters:—"The superior antennæ are as long as the inferior, and not furnished with a secondary appendage. The mandibles are not furnished with an appendage. The maxillipedes are pediform, unguiculate, and without, or with only rudimentary, squamiform plates. The first pair of gnathopoda are small, subchelate, the coxæ not developed into a squamiform plate. The second pair of gnathopoda are larger than the first, and have the coxæ very large, squamiform, deeper than the body, and produced anteriorly, so as to cover the organs of the mouth; the propodos is developed upon the same type as in the first pair. The pereiopoda are subequal; the coxæ of the two anterior pairs are very largely developed,

deeper than the body, and produced posteriorly, so as to cover that of the following pair of pereiopoda. The posterior pair of pleopoda are styliform, unibranched, the ramus biarticulate. The telson is simple and squamiform."

Montaguana miersii?

(? *Montaguana miersii*, Haswell, Proceedings Linn. Soc. N.S.W., vol. iv., p. 323, pl. XXIV., fig. 4, and Cat. Australian Crust., p. 226.)

"Coxæ of the posterior gnathopoda and the two first pairs of pereiopoda much deeper than their respective segments. Superior and inferior antennæ subequal in length, equal in length to the cephalon and first three segments of the pereion; the peduncles stout, rather shorter than the flagella. Anterior gnathopoda small, the propodos subquadrate, the palm nearly transverse. Posterior gnathopoda with the propodos large, cordiform; the palm oblique, undefined. Pereiopoda subequal, rather stout. Colour yellow with brown markings. Length about $\frac{3}{20}$ in."

Hab. Timaru and Lyttelton Harbour.

Mr. Haswell obtained his specimens at Port Jackson. Mine differ from the description and figures given by him in some small points so that I am rather doubtful whether they are really the same species or not.

The first pair of gnathopoda has the palm more oblique than shown in Mr. Haswell's figure. In the second gnathopoda the specimens obtained at Timaru differ somewhat from those obtained at Lyttelton, though much too close in other respects to be considered as distinct species. The Lyttelton specimens are nearest to those described by Mr. Haswell. The palm, though it can hardly be called defined, yet has two stout setæ at the place where the end of the finger reaches to, one on each side; on the under-side of the propodos towards the base are a few rather long setæ, not shown in Mr. Haswell's figure; and in the centre of the palm is a small sharp projection. In the Timaru specimens the propodos is much stouter, palm less oblique, and without the small projection at its centre.

In the last three pairs of pleopoda my specimens closely resemble those of *M. longicornis* as figured by Mr. Haswell. In the figure of *M. miersii* the last pair of pleopoda are drawn with two rami, but this must, I suppose, be a slip of the artist's.

Genus **Cyproidia**, *Haswell.*

(Proc. Linn. Soc. N.S.W., vol. iv., p. 320, and Cat. Aust. Crust., p. 229.)

"Body broad. Pereion and pleon of equal length. Coxæ of gnathopoda very small. Coxæ of the first and second pairs of pereiopoda enormously developed, and cemented together to form broad and deep lateral shields, concealing almost entirely the gnathopoda and pereiopoda, and extending forwards to the sides of the cephalon, and backwards as far as

the posterior border of the sixth segment of the pereion, excavated posteriorly for the shallow coxæ of the third pereiopoda. Coxæ of last two pairs of pereiopoda very small. Antennæ subequal superior without an appendage. Mandibles with a palp. Maxillipedes unguiculate; both basos and ischium armed with small squamiform plates. Gnathopoda subcheliform. Pereiopoda slender. Posterior pleopoda biramous. Telson single."

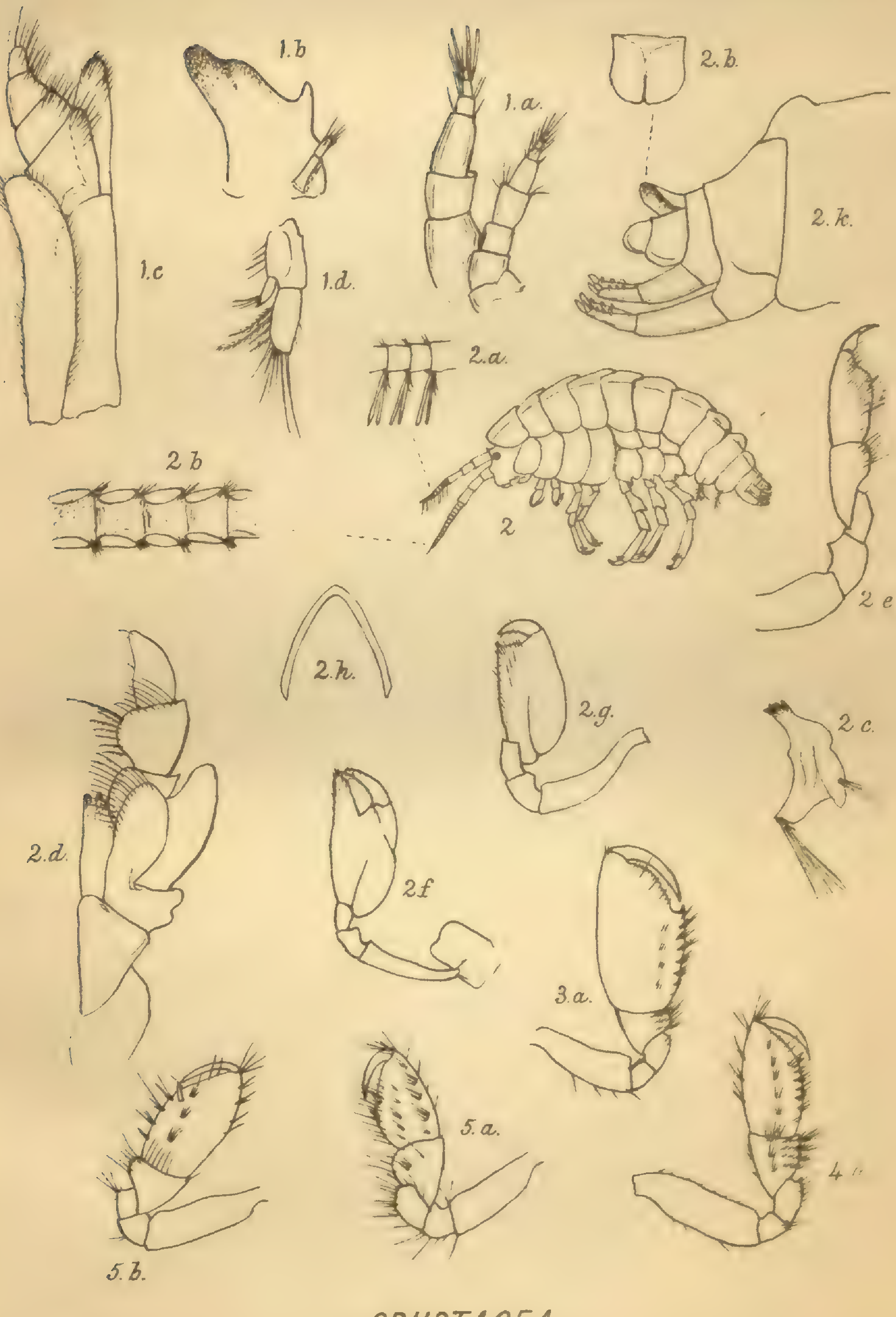
Cyproidia (?) *crassa*, sp. nov. Pl. III., fig. 1.

Eyes large. All the mouth parts and nearly all the lower antennæ concealed by the coxæ of the two pairs of gnathopoda and the first pair of pereiopoda. Coxæ of first pair of gnathopoda triangular about as deep as its segment, extending anteriorly over the mouth parts, posterior edge slightly curved. Coxæ of second gnathopod and first pereiopod deeper than their segments, rather narrow, slightly curved. Coxæ of second pair of pereiopoda enormously developed, much deeper than its segment and extending posteriorly as far as the posterior border of the seventh segment of pereion, excavated above, posteriorly for the shallow coxa of the third pereiopod. Coxæ of last two pairs of pereiopoda rudimentary, hidden. The coxæ of the two gnathopoda and the first two pereiopoda united together to form deep broad lateral shields which enclose all but the ends of the pereiopoda. Upper antennæ with first two joints of peduncle stout, subequal, the second produced above into a strong tooth, third joint small and indistinguishable from the flagellum; flagellum nearly as long as peduncle bearing on its under surface long auditory cilia. First joint of peduncle of lower antennæ large, second joint shorter, articulated to the first by a geniculate joint, third joint longer than second but not quite so long as the first followed by a short flagellum about as long as the third joint of peduncle. Two pairs of gnathopoda equal in size and similar in shape, meros and carpus both having the inner distal angle produced into a lobe setose at the end, propodos rather small, hairy, some of the hairs on the palm strong, plumose at tip, dactylos rather small, slightly curved at the tip; the gnathopod appears to be but very imperfectly subchelate. Pereiopoda subequal, setæ few, short. Of the last three pairs of pleopoda the first is the longest, peduncle rather slender, rami slender, lanceolate, nearly equal, almost naked, second similar but with rami more unequal, last stouter, rami unequal, naked. Telson oval, slightly narrower towards the end than at base, margins entire, no setæ. Colour—brown.

Length, about $\frac{1}{7}$ inch.

Hab. Lyttelton harbour.

As will be seen from the figure and the description already given, this species differs very considerably in the form of the coxæ from Mr. Haswell's species for which he made the genus; it will most probably form the type



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of a new genus, but, as I have only had two specimens, both of the same species, I prefer to leave it under Mr. Haswell's genus for the present. The details (fig. 1 *a-d*) were taken from a small specimen, and hence may not represent quite accurately their form in more adult specimens.

Genus **Moera**, *Leach.*

(Cat. Amphip. Crust. Brit. Mus., p. 187.)

Moera spinosa, Haswell. (Proc. Linn. Soc. N.S.W., iv., p. 268, pl. x., fig. 5; and Cat. Aust. Crust., p. 257.)

"Posterior margin of the five anterior segments of the pleon armed with a few acute teeth or spines; fourth and fifth segments armed behind with acute spines. Coxæ much shallower than their respective segments. Lateral plate of the third segment of the pleon serrated posteriorly. Eyes long, oval. Superior antennæ more than half the length of the body; first segment of peduncle as long as the cephalon and first segment of the pereion; second rather longer; third very short; flagellum as long as the peduncle; appendage nearly half as long as the flagellum.*

"Inferior antennæ more than half as long as the superior pair; third segment of peduncle equal in length to the first segment of the pereion; fourth twice as long as the third, fifth as long as the cephalon; flagellum as long as the fifth segment of the peduncle. Anterior gnathopoda hairy, carpus rather longer than the propodos; the latter ovate; palm oblique, notched. Posterior gnathopoda with the propodos large, ovate, more dilated in the male than in the female, palm defined by a strong acute tooth, and armed in the male with two other prominent teeth. Two anterior pairs of pereiopoda sub-equal. Third pair rather shorter than the fourth and fifth; basos of the three posterior pairs produced at its postero-distal angle; meros, carpus, and propodos serrated and hairy. Fifth pair of pleopoda much shorter than the fourth. Sixth pair large, with a stout protopodite and two broad-lanceolate rami, the latter serrated and armed with setæ. Telson double, each half ending in a sharp spine, and armed with a bundle of stiff setæ. Length 8 lines."

Hab. Auckland.

Of this species I have two specimens, a male and a female, for which I have to thank Professor Hutton. He found them in a collection of Mollusca sent him from Auckland. Mr. Haswell's specimens were from Tasmania. In my specimen of the male the second gnathopod of the right side only has the two promiment teeth on the palm, and these are rather larger and more blunt at the end than those shown in Mr. Haswell's figure; the second gnathopod of the left side is like those of the female, having the palm slightly convex, and without the two teeth. (See plate II., fig. 3*a*.)

* In the Catalogue this is by an error printed "appendage nearly as long as the flagellum."

Moera petriei, G. M. Thomson. (Trans. N.Z. Inst., xiv., p. 236, pl. xviii., fig. 3).

This species was described by Mr. Thomson from specimens obtained at Port Pegasus in the dredge. I have found it pretty abundantly in Lyttelton Harbour at low tide. The female differs from the male in the form of the second pair of gnathopoda. In these the carpus is much longer than in the male, being slightly longer than broad; it is densely haired, the hairs being chiefly arranged in rows; many if not all these hairs are serrated; the propodos is only very slightly broader than the carpus, having tufts of setæ along both sides and also along the middle, those on the under surface being the most numerous and the thickest. Palm imperfectly defined by several strong setæ at the point where the tip of the dactylos impinges. Dactylos slender, very acute. (See plate II., fig. 4*a*.)

In the male my specimens have the propodos of the gnathopoda less hairy than the one drawn by Mr. Thomson, and the dactylos is more blunt, being quite rounded at the end.

The two acute spines on the postero-dorsal margin of the fourth segment of the pleon are invariable in both sexes.

Genus **Harmonia,** *Haswell.*

(Proc. Linn. Soc. N.S.W., vol. iv., p. 330, and Cat. Aust. Crust., p. 250.)

Generic characters:—"Coxæ not so deep as their respective segments. Superior antennæ with an appendage. Inferior antennæ longer than the superior pair. Mandibles with a palp. Maxillipedes unguiculate, subpediform, provided with a squamiform plate on the basos only. Gnathopoda subchelate, unequal, posterior pair very large. Pereiopoda stout. Posterior pleopoda biramous, the rami short, conical. Telson single, elongate."

Of this genus Mr. Haswell says: "This genus, of which I have as yet observed but one species, has affinities with *Eurystheus* and *Amathia*, but is distinguished from the former by the form of the telson and the stoutness of the pereiopoda, and from the latter mainly by the large size of the posterior gnathopoda."

Before noticing Mr. Haswell's genus I had found the following species, and had begun to describe it as a new species of *Eurystheus*.

Harmonia crassipes, Haswell. (l.c., p. 330, pl. xix., fig. 3.)

"Superior antennæ as long as the cephalon and first six segments of the pereion, first and second segments of the peduncle subequal, the second narrower than the first, third scarcely distinguishable from the articuli of the flagellum; flagellum rather longer than the peduncle. Inferior antennæ longer than the superior pair; peduncle and flagellum subequal. Anterior gnathopoda small; propodos ovoid; palm oblique, undefined. Posterior gnathopoda much larger than the anterior pair; carpus sub-

triangular; propodos irregularly ovoid, palm oblique, excavate, defined by a triangular tooth, and armed with another of similar form near the distal end. Two anterior pairs of pereiopoda subequal; three posterior pairs with the basa oblong twice as long as broad, the other joints very broad, the dactylos very stout; fourth pair smaller than the fifth and sixth. Rami of fourth pair of pleopoda as long as the protopodite; those of the fifth pair shorter; those of sixth pair very short, conical, armed with a few straight setæ. Telson simple, conical, compressed. Colour brown. Length, $\frac{3}{20}$ inch."

Hab. Lyttelton Harbour; Timaru.

This species is moderately common at Lyttelton Harbour; Mr. Haswell's specimens are from Port Jackson. The female differs from the male in the form of the second gnathopoda. The first gnathopoda are like those of male, and are shown in pl. II., fig. 5 *a*. They are very hairy, and at the inferior edge of the palm are two stout setæ. The second gnathopoda of female are much smaller than those of the male, the carpus is subtriangular and larger than the carpus in the second gnathopoda of male, it has its distal and inferior borders setose; propodos only slightly broader than the carpus, long ovate, with small tufts of setæ on the two sides and on the middle, palm oblique imperfectly defined by a stout seta on each side at the end of the dactylos.

Genus **Moera.**

Moera incerta, sp. nov. Pl. III., fig. 3.

None of the segments of pleon or pereion produced into teeth. Coxæ shallower than their respective segments. Basal joint of upper antenna stout, narrowing distally, second joint only slightly longer than the first, third joint short; flagellum shorter than peduncle, about as long as the basal joint and half the second; secondary appendage rather more than half as long as the flagellum; setæ on the antenna short and very fine. Lower antenna shorter than the upper, slender; peduncle as long as that of upper antenna, last joint of peduncle slightly shorter than the preceding joint, flagellum short, not quite so long as the last joint of the peduncle, setæ short and delicate. First pair of gnathopoda having the carpus about as large as the propodos; its outer edge with a shallow notch towards the distal end, inner edge densely fringed with setæ, small tufts of setæ scattered over the joint; propodos ovate, not very hairy, palm slightly convex, fringed with short setæ, imperfectly defined by one or two stout short setæ; dactylos slender acute, with one or two long setæ at its base. Second pair of gnathopoda very large, carpus rather small subtriangular, propodos very large, subrectangular, slightly narrowed at the base, inner margin slightly sinuous, with a few small tufts of setæ

chiefly on the proximal half; on the outer margin mostly towards the distal part are also a few small tufts of setæ, but these lie close along the joint and are very easily overlooked. Palm transverse defined by a short stout tooth and having short stout setæ along the whole palm. Dactylos thick and strong, not longer than palm. First two pairs of pereiopoda subequal, rather slender, last three broad, increasing slightly in size posteriorly, basos moderately large subrectangular, anterior edge with a few small setæ, posterior edge minutely serrate, a very minute seta arising at each serration, meros broad serrated, with moderately long strong setæ, carpus expanding somewhat distally, setose; propodos setose on anterior side only, numerous strong setæ arising at the base of the dactylos; dactylos considerably narrower than propodos, ending in two sharp points, the principal one longer and more curved than the other. Inferior edges of first three segments of pleon supplied with several small setæ. Posterior pair of pleopoda only reaching very slightly beyond the two preceding pairs, of which the first pair is slender, having the peduncle considerably longer than the rami, rami with long strong setæ at their extremities; second pair stouter, rami with similar long strong setæ at end; third pair having the rami broad and setose more especially on the outer edge. Telson double, each half concave posteriorly with two long setæ arising from the hollow, and having another hollow on the outer side towards the distal end with a single seta springing from the hollow.

Length, about $\frac{1}{5}$ of an inch.

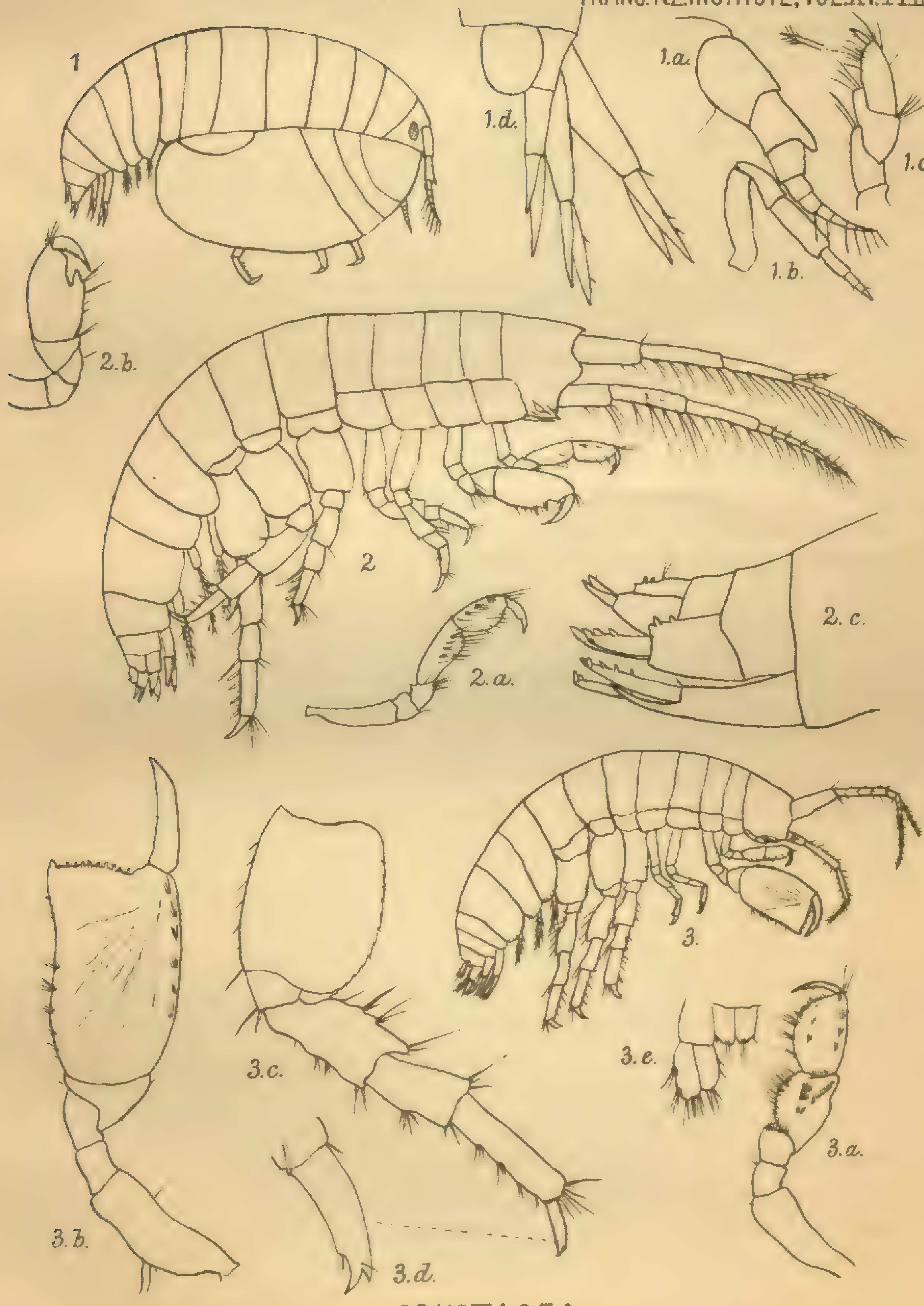
Hab. Lyttelton Harbour.

This species is very close to *M. quadrimanus*, Dana, *M. grossimanus*, Montagu, *M. viridis*, Haswell, *M. truncatipes*, Spinola, but differs from all in the form of the second pair of gnathopoda. In this respect it closely resembles *M. blanchardi*, Spence Bate, but differs in having the basa of the three posterior pairs of pereiopoda dilated, in having the secondary appendage of upper antenna not so long as the primary flagellum, and in other points. It also resembles *M. tenella*, Dana, but that species has the base joint of upper antenna "not stout, second very long;" the two species also appear to differ somewhat in the form of the second gnathopoda, and also in the length of the posterior pair of pleopoda.

Genus **Podocerus**, *Leach.*

(Cat. Amphip. Crust. Brit. Mus., p. 252.)

"Eyes small, situated on a lobe between the superior and inferior antennæ. Superior antennæ having a secondary appendage, which is generally very minute. Inferior antennæ robust, the flagellum consisting of but few articuli and as stout as the peduncle, the hairs towards the extremity being developed into spines, which increase in strength as they



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approach the apex, where they become curved. Second pair of gnathopoda having the propodos (in the male) much larger than that of the first pair. Two anterior pairs of pereiopoda short, having the basa very broad. Posterior pair of pleopoda having two rami, one of which is armed with one or more hooked spines. Telson squamiform."

Podocerus frequens, sp. nov. Plate III., fig. 2.

Eye moderately large round. Superior antenna as long as the inferior; first joint of peduncle stout, next two joints longer, equal in length, slender, flagellum considerably longer than the last joint of peduncle, secondary appendage of two or three joints; the whole of the inferior margin of antenna thickly fringed with long setæ. Inferior antennæ slender, last two joints of flagellum equal and longer than the preceding one, flagellum considerably longer than the last joint of the peduncle, inferior border of antenna fringed with long setæ; spines on flagellum even at the end are not much curved and not very strong. First pair of gnathopoda long but not very stout, carpus longer than propodos, hairy; propodos ovate hairy, dactylos with proximal half of inner edge serrate, distal half smooth. Second gnathopod with carpus short, triangular, propodos large, produced inferiorly into a strong tooth against which the dactylos impinges, dactylos strong proximal half of inner edge serrated. First two pairs of pereiopoda subequal, stout. Last three pairs stout, third smaller than the fourth and fifth. Last three pairs of pleopoda short all reaching to the same point; first pair the longest, rather slender, peduncle longer than the rami and produced between them into a sharp slightly curved spine which is about two-thirds as long as the rami; rami with short teeth on upper margins curving upwards; second pair with stout peduncle, rami more slender than peduncle, curved teeth on upper margins of peduncle and rami; last pair with stout peduncle narrowing at apex, rami small slender, nearly naked. Telson with two curved spines, and anterior to these one or two simple setæ.

Female.—Differs from above in having the propodos of second gnathopoda less stout and wanting the strong process, but with two stout setæ towards the end of the palm.

Length about $\frac{1}{10}$ of an inch.

Hab. Lyttelton Harbour.

This species appears closely to resemble *P. validus*, Dana, from Rio Janeiro, but that species has the inferior antennæ "very stout."

The process on the propodos of second gnathopoda of male varies in size in different specimens, and is often longer and more distinct than shown in fig. 2*b*.

EXPLANATION OF PLATES I.—III.

Plate I.

Fig. 1. *Scutuloidea maculata* × 12; *a*, inner antenna × 40; *b*, auditory seta from same, more highly magnified; *c*, mandible × 40; *d*, first maxilla × 40; *e*, second maxilla × 74; *f*, seta from outer lobe of same highly magnified; *g*, inner lobe of same × 160; *h*, maxillipede × 40; *k*, first thoracic leg × 15; *l*, end of same × 40; *m*, second thoracic leg × 15; *n*, end of same × 40; *o*, one of the pleopoda × 30; *p*, abdomen from below × 12.

Fig. 2. *Hymenosoma lacustris; a*, third (external) maxillipede × 10; *b* and *c*, different forms of setæ from the same, more highly magnified; *d*, chela of male × 8; *e*, abdomen of male × 15.

Fig. 3. *Cubaris rugulosus; a*, inner antenna × 40; *b*, outer antenna × 10; *c*, scale-like markings on the integument × 120.

Fig. 4. *Anthura affinis; a*, antennæ from above × 23; *b*, first thoracic leg × 15; *c*, second thoracic leg × 13; *d*, extremity of same, more highly magnified; *e*, abdomen, with telson and last pair of pleopoda, from above, × 30; *f*, first pleopod × 30.

Fig. 5. *Plakarthrium typicum* × 12; *a*, inner antenna × 18; *b*, outer antenna × 18; *c*, mandible × 120; *d*, first thoracic leg × 18; *e*, extremity of same × 75; *f*, third thoracic leg × 40; *g*, one of the pleopoda × 30; *h*, another form of the pleopoda × 30; *k*, last pair of pleopoda × 24.

Plate II.

Fig. 1. *Limnoria segnis; a*, antennæ from above × 60; *b*, mandible × 120; *c*, maxillipede × 120; *d*, appendage of sixth segment of pleon × 40.

Fig 2. *Nicea egregia*, female × 6; *a*, portion of flagellum of upper antennæ with auditory cilia × 40; *b*, portion of flagellum of lower antenna × 60; *c*, mandible × 40; *d*, maxillipede × 60; *e*, first gnathopod × 30; *f*, second gnathopod of fully developed male × 13; *g*, second gnathopod of young male × 13; *h*, transverse section through one of the segments of pereion of male × 15; *k*, extremity of pleon × 30; *l*, telson, from above × 40.

Fig. 3. *Moera spinosa; a*, second gnathopod of female, which is the same as second gnathopod of left side of male × 13.

Fig. 4. *Moera petriei; a*, second gnathopod of female × 13.

Fig. 5. *Harmonia crassipes; a*, first gnathopod of female × 35; *b*, second gnathopod of female × 35.

Plate III.

Fig. 1. *Cyproidia (?) crassa* × 30; *a*, upper antenna, and *b*, lower antenna, in position, × 70; *c*, first gnathopod × 70; *d*, telson and three posterior pleopoda from above × 120.

Fig. 2. *Podocerus frequens* × 30; *a*, first gnathopod × 40; *b*, second gnathopod of male × 30; *c*, extremity of pleon × 70.

Fig. 3. *Moera incerta* × 13; *a*, first gnathopod × 30; *b*, second gnathopod × 30; *c* fifth pereiopod × 30; *d*, dactylos of same × 120; *e*, telson and last pair of pleopoda from above × 30.

ART. III.—*Notes on, and a new Species of Subterranean* Crustacea.

By CHARLES CHILTON, M.A.

[*Read before the Philosophical Institute of Canterbury, 5th October,* 1882.]

Plate IV.

*Corrections and Additions to previous Paper.**

IN my previous paper I have stated that the well from which the Crustacea were obtained was "not more than twenty-five feet deep." I have since found that this is considerably too much, it is really only sixteen or seventeen feet deep; since then, however, the well has been filled in, so that it is now practically the same as though the pipe had been simply driven into the ground as in an artesian well.

The Crustacea still continue to come up, though not so frequently as before, and they now vary more, sometimes coming up pretty abundantly while at other times they are very scarce; and while previously *Calliope subterranea* (female) used to be much more abundant than any of the other species, it now, though still more abundant than the others, does not preponderate over them nearly so much as before. Next come *Crangonyx compactus* and *Cruregens fontanus* which occur in about equal numbers, while *Gammarus fragilis* is now the rarest of all.

From another pump about two or three chains from the first, I have obtained a few specimens of *Calliope subterranea* (female), and from a third pump about a mile and a half distant I got a single specimen of *Gammarus fragilis*, and I have heard of similar animals being seen from another pump about a mile distant from the first one, but I have not seen specimens from this well. These facts seem to show that the Subterranean Crustacea are fairly well distributed in the district.

All these wells are sunk in a bed of gravel which lies immediately under the surface soil. Through this gravel water continually percolates, and can always be found at the depth of a few feet from the surface, the depth varying according to the situation, the dryness of the season, the state of the neighbouring River Eyre, etc. I do not think that there is anywhere any large connected quantity of water, but I believe that the Crustacea live in the water which percolates through the interstices between the stones in the bed of gravel.

With regard to the origin of these *Crustacea* one can as yet only conjecture. Their nearest allies appear to be marine in their habitat. *Cruregens fontanus* would, but for the absence of the last pair of thoracic legs, come under the genus *Paranthura*, the species of which, as well as of the allied genus *Anthura*, are all marine. Besides *Cruregens fontanus*, I have obtained

* "On some Subterranean *Crustacea*," "Trans. N.Z. Inst.," vol. xiv., p. 174.

another Isopod (described in the latter part of the paper) whose nearest allies are marine. *Calliope subterranea* is inconclusive, for we have in New Zealand one marine and one fresh-water species; it is, however, not at all near to *C. fluviatilis* the fresh-water species, and certainly has not arisen out of that species.

Gammarus fragilis, again, does not prove anything, for though in New Zealand we have only one species, a marine one, in Europe some species are marine and some fresh-water. The genus *Crangonyx* contains only two species besides *C. compactus*, mihi, one *C. subterraneus* from a well in England, the other *C. ermanni* from warm springs in Kamschatka; its nearest allied form, however, is a marine genus, *Gammarella*.

On the whole, both the Isopoda and the Amphipoda are so distinctly marine and their fresh-water representatives in New Zealand so few, in fact only two, *Calliope fluviatilis* and *Idotea lacustris*, that it is difficult to believe that the subterranean fauna, which, so far as at present known, contains five species, could have arisen from any other than the marine fauna.

Cruregens fontanus.—Since writing my previous paper I have obtained a great number of specimens of this species—between 40 and 50—and they all agree in having the last thoracic segment small and without appendages, so that there can no longer be any doubt that the form I have described is the adult form.

In living specimens the heart can be distinctly seen through the transparent integument. It is elongated and extends from the middle of the fifth abdominal segment anteriorly, reaching nearly to the middle of the sixth thoracic segment. The anterior end of the heart is narrower than the posterior part, and the posterior end is rounded. There appear to be three openings through which blood flows into the heart; one is on the left side in the second abdominal segment; the other two are on the right side, one in the seventh (last) thoracic segment, and the other in the third abdominal segment. These openings appear to be provided with valves of some kind. Blood passes out through the anterior end of the heart, in the median line of the body, and flows forwards to supply the various parts of the body.

In my previous paper I have stated that the only blind Isopoda inhabiting wells or caves that I could find mention of were two species of a genus, *Cacidotea*, found in the Mammoth Cave of Kentucky and in the Wyandotte Cave; since then I have found two others mentioned, but I have not been able to get descriptions of them; they are *Titanethes albus*, Schiödte, which inhabits caves of Carniola* and *Typhloniscus steinii*.† ‡

* See "Nature," 18th April, 1872, p. 484.

† See "Trans. Linn. Soc.," 2nd ser., vol. I., pt. i., p. 24 (footnote).

‡ Others are mentioned in the Zoological Records for 1879 and 1880.

I have now to add another obtained from the same well as the other Subterranean Crustacea that I have described.

Genus **Phreatoicus**, (*novum*).

Body long, sub-cylindrical, laterally compressed. Upper antenna short, lower long, with flagellum. Mandible with an appendage. First pair of legs subchelate, others simple; first *four* pairs articulated to body at the anterior ends of their segments and directed forwards, last *three* articulated at posterior ends of their segments and directed backwards. Abdomen long, of six distinct segments, last joined to telson. Sixth pair of pleopoda biramous, styliform. Telson large, subconical.

Phreatoicus typicus, sp. nov. Pl. IV.

Eyes not visible. Upper antenna about half as long as the peduncle of the lower antenna, consisting of about eight joints, peduncle not distinguishable from the flagellum, last three or four joints thicker than the preceding. Lower antenna about three-fourths as long as the body, peduncle of five joints, first two short, third longer but not so long as the fourth, fifth nearly as long as the third and fourth together. First pair of legs subchelate, propodos rather small, palm oblique, defined by densely haired knob; finger strong, hairy; next three pairs of legs subequal, rather stout; last three longer, setose, increasing regularly in length from before backwards. First segment of pereion only about half as long as the second, remainder subequal. Pleon two-thirds as long as pereion, first segment small, next three subequal, fifth large, about as long as the preceding three together, the second, third, fourth and fifth segments having the integument produced inferiorly, and the inferior edge fringed with short stout setæ. Sixth segment joined to telson and bearing a pair of biramous pleopoda; peduncle longer than rami, outer ramus shorter than inner. Telson large, subconical, deeply concave below, inferior edge irregularly serrate and fringed with very short setæ; regularly rounded above, extremity projecting backwards, with short setæ on tip, and a stout one on each side of the base.

Colour—transparent.

Length, about half an inch.

Hab. Pump at Eyreton.

Additional remarks on structure:—

The upper antenna (pl. IV., fig. 2) is peculiar in having the last three or four joints considerably thickened, the thickening being chiefly due to the increased thickness of the integument. Small simple auditory cilia are found on the under side of the antenna (fig. 2 *a*).

The lower antenna (fig. 3) has already been sufficiently described.

The mouth parts are shown in position in fig. 4. In front is the labrum (*a*), the end of which is densely beset with fine setæ projecting radially from the tip as centre. When dissected out the labrum appears to consist of two plates each more or less triangular (fig. 6).

The mandible is strong, it bears a three-jointed appendage, second joint the longest, third fringed on one side with setæ projecting perpendicularly to the joint and increasing regularly in size towards the distal end of the joint. There is a large molar tubercle, the end of which seems to bear rows of short setæ.

The cutting end of the mandible consists of two sharp teeth, one longer than the other; below this there is a movable portion also ending in sharp teeth, and below this again a double row of strong setæ. (See fig. 5.)

The first maxilla (fig. 7) consists of two plates, the outer longer than the inner, bearing at the end strong setæ, some of which are branched, the outer edge and inner portion thickly covered with long very fine setæ; the inner lobe bears on the rounded end several long setæ, somewhat separated from each other, each plumose more especially towards the end; the distal and inner portions thickly covered with fine setæ similar to those on the outer lobe.

The second maxilla (fig. 8) consists of a stout basal portion bearing three overlapping plates: on the outer plates are long setæ, each bearing short pieces projecting at right angles to the seta. (See fig. 8*a*.)

On the third and inner plate are long plumose setæ, and on the inner edge of the base is a row of long plumose setæ similar to those on the inner lobe. The whole of the inner lobe, the inner portions of the two outer lobes, and some parts of the base, are covered with fine setæ similar to those on the first maxilla.

The maxillipede (fig. 9) bears at the base an irregularly rounded plate (fig. 4 *f*) which probably is homologous with a similar plate found in *Idotea* and *Limnoria*; the basal joint is long, its inner edge towards the distal end is fringed with long plumose setæ, and there is a lobe apparently connected with the first joint; this lobe bears plumose setæ on the inner edge, and simple setæ on the outer side and distal end. The other joints of the maxillipede present nothing remarkable, and their form can be best understood from the figure.

The coxæ of all the legs can be readily seen to be simply the basal joints of the legs. In the first four pairs of legs the coxa projects slightly forwards, and is tipped with a few short setæ; in the last three pairs it projects backwards similarly. (See fig. 11.)

In the first pair of legs the distal end of the meros is produced anteriorly and is fringed with setæ, the carpus is longer than broad and

has a tuft of setæ on the inner edge, the propodos is not very large; in the centre of the palm are a few short hairs set on the tip of small teeth-like projections. The other legs present nothing remarkable; the last three are abundantly covered with long stout setæ (see fig. 11); in all the dactylos is slender and the end forms a distinct claw having setæ arising at its base (fig. 11*a*).

In the pleon a somewhat remarkable feature is presented by the segments (except the first) having the integument produced downwards as in the first three segments of the pleon in Amphipoda, thus forming lateral shields protecting the pleopoda. The first pair of pleopoda differs from the others; it consists of a small basal joint bearing two oblong plates, the large one having a few setæ at the end (fig 12). It appears to form an imperfect operculum for the other pleopoda. In the others there is a basal joint as before; from this spring two lobes, the smaller oval with margin entire, the larger sub-oblong, inner edge fringed with simple setæ and bearing at the end another small joint fringed with plumose setæ (fig. 13).

The sixth segment of pleon is united to the telson, its inferior edge bears four strong slightly curved setæ. The sixth pleopod is more like one of the last three pairs of pleopoda in Amphipoda than anything I know of among the Isopoda; the upper surface of the peduncle is broad and slightly concave, the outer upper edge fringed with setæ, while the inner upper edge is straight. At the end of the peduncle there is one strong seta below and two or three above, the rami are sharply pointed and bear both stout setæ and longer fine hairs (fig. 14).

Throughout the whole of the body and the appendages the integument is covered with very short setæ arranged more or less regularly in interrupted rows. These setæ are very small and can scarcely be seen without a $\frac{1}{4}$-in. objective (fig. 15). Besides this along the dorsal surface are scattered a few long fine hairs.

The alimentary canal is generally full of black matter of some kind,—food, I suppose,—and hence can be readily seen through the transparent integument. It is shown in fig. 1.

The animal I have thus described is interesting and important, because it combines characters belonging to different groups. In the elongated form of the body, in the antennæ and in the plate at the base of the maxillipede, it resembles *Idotea*, it differs very much from this genus, however, in the form of the abdomen and in the fact that the mandible has an appendage. In this latter respect and in the cylindrical elongate body it resembles *Anthura* and *Paranthura*, and it thus to a certain extent serves to connect the *Anthuridæ* with the *Idoteidæ*. In the long abdomen composed of separate segments it differs both from the *Anthuridæ* and the

Idoteidæ and approaches the *Tanaidæ*. The legs consist of an anterior series of four, and a posterior series of three, and this, according to the figures given by Bate and Westwood, appears to be the case with the *Tanaidæ*. This peculiarity is also possessed by the Amphipoda to which *Phreatoicus* has a considerable superficial resemblance due chiefly to the flattened form of the body, best seen in the abdomen, and to the fact that the segments of the pleon have the integument produced downwards, but also to the Amphipodan facies of the legs and the last pair of pleopoda.

The precise place of *Phreatoicus* in any system of classification cannot as yet be indicated with certainty, but one thing is made clear by the discussion, viz., that *Phreatoicus*, possessing as it does affinities to several distinct groups, must be of very considerable antiquity.

The occurrence of this species has been somewhat remarkable. Ever since January, 1881, I have collected or had collected for me all the Crustacea that were observed to come up; nothing new was found until the beginning of September, 1882, when a single specimen of *Phreatoicus* was obtained, and in the short time since then six other specimens have been found.

DESCRIPTION OF PLATE IV.

Phreatoicus typicus.

Fig. 1. Lateral view of the animal × 5.
2. Upper antenna × 30; *a*, auditory cilium from the same, more highly magnified.
3. Base of lower antenna × 13.
4. Side view of the head, showing the mouth organs in position, × 15; *a*, labrum; *b*, mandible with appendage; *c*, the two lobes of first maxilla; *d*, second maxilla; *e*, maxillipede with *f*, the rounded plate at its base.
5. Mandible, view of inner side × 30.
6. Labrum × 30.
7. First maxilla × 30.
8. Second maxilla × 30; *a*, seta rom middle lobe of same, more highly magnified
9. Maxillipede × 30.
10. Distal portion of first thoracic leg × 30.
11. Seventh thoracic leg × 13; *a*, end of same × 30.
12. First pair of pleopoda × 13.
13. Second pair of pleopoda × 15.
14. Extremity of abdomen, side view, × 14.
15. Portion of the integument × 120.

Art. IV.—*On the New Zealand* Copepoda. By Geo. M. Thomson, F.L.S.

(Read before the Otago Institute, 9th May, 1882.)

Plates V. to XI.

In the N.Z. Inst. Trans., Vol. XI., pp. 258–259, I described two species of Entomostraca belonging to the Order Copepoda—viz., *Cyclops novæ-zealandiæ* and *Arpacticus bairdii.* I had numerous other forms in my collection at the time, but, from want of text-books on this little-known order, was unable with any certainty to work them out. This difficulty having been in great measure overcome, I am now enabled to contribute a little information to our knowledge of this interesting group of animals.

The forms described in this paper have been obtained from only a few situations, the marine species being either from rock-pools or shore-kelp along the coast, or taken by the dredge in Otago Harbour at a maximum depth of 6 fathoms. Small as the number of species already identified is, they show a remarkable approximation to European forms. As the literature of the subject is not readily accessible to members of the N.Z. Institute, I make no apology for introducing generic characters. The classification followed is that adopted by Brady in his beautiful "Monograph of the British Copepoda," recently issued by the Ray Society.

Of the 8 families represented in the British fauna, I have only met with representatives from 4—namely, Calanidæ, Cyclopidæ, Harpacticidæ and Artotrogidæ.

(Note.—Four species of Copepoda were obtained by Dana near New Zealand, and are described in the "Crustacea of the U.S. Exploring Expedition (1855);" they are *Pontella valida, Pontellina simplex, Sapphirina gemma* and *Miracia gracilis*).

Fam. CALANIDÆ.

Sub-fam. Calaninæ, *Dana.*

Eye single, composed of several lenses; thorax and abdomen long and slender; rostrum (if present) slender, and usually fuscate; anterior antennæ 24–25-jointed.

Genus **Boeckia,*** gen. nov.

Body elongated, compressed; head not distinct from thorax. Abdomen consisting of five segments in the male, and of three in the female. Right anterior antennæ of the male geniculated. Posterior antennæ two-branched, the secondary branch having four small intercalated median joints. Mandibles large, with a sharply toothed cutting portion, and a broad palp; the latter bears two branches, one four- and the other three- (or two-) jointed. Maxillæ furnished with numerous strong marginal plumose setæ. Anterior

* In honour of Axel Boeck, author of several works on Copepoda.

footjaws broad, setæ numerous; posterior pair much elongated, terminal portion five-jointed, and furnished with several setæ of moderate length. Five pairs of swimming feet, all two-branched, and each branch of the first four pairs three-jointed and almost similar; fifth pair with both branches three jointed in the female, but outer branch two-jointed in male, with a long terminal curved (apparently prehensile) claw, inner branch somewhat rudimentary, one-jointed. Ovisac single, borne in front of the abdomen.

It is with some hesitation that I advance this new genus, but as the chief systematists who have studied the *Calanidæ* treat the structure of the inner branches of the swimming feet as of primary importance in the classification of the genera, no other course was open to me. The genus belongs to the same section as *Isias* (Boeck), and *Centropages* (Kröyer). The former is its nearest ally, but differs in having the inner branch of the fifth pair of feet in the female one-jointed, while in the male the outer branch consists of two, and the inner of one or two joints. In *Centropages*, the strong bristles on the anterior footjaws point to its affinity with the sub-family *Pontellinæ*, and the outer branch of the fifth pair of feet in the male is developed into a powerful grasping claw on the right side only, while the inner branch is normally three-jointed.

1. *Boeckia triarticulata*, sp. nov. Pl. VI., fig. 1.

Body elongated, rounded above, last thoracic segment produced into a strong spine on its infero-posterior margin. Anterior antennæ almost as long as the body: that of the male on the right side swollen in the middle, hinged between the 19th and 20th joints, and bearing denticulated plates on the inner face of the 18th and 19th joints above, and on the 20th joint below the hinge; spines and setæ rather few. Fifth pair of feet in the female somewhat similar to preceding pairs, but with the middle joint of the outer branch produced internally into a strong toothed spine (in this respect resembling to some extent *Centropages typicus*), inner branch rather reduced in size; in the male the outer branch is distended and two-jointed, with a long terminal curved claw, which is longer and more slender on the left than on the right side. Caudal segments about as long as last abdominal segments, and bearing five densely plumose rigid setæ, which are shorter than the abdomen.

Length (including caudal setæ) $\frac{1}{10}$ inch; spread of anterior antennæ, $\frac{1}{7}$ inch.

Hab. This interesting species was obtained in shingle-pits (fresh water) at Eyreton, in the North Canterbury District, by Mr. Chas. Chilton. Most of the specimens are reddish in colour, but the colouration is very variable both in intensity and localization.

(*P.S.*—The generic name *Boeckia* was, I find, originally proposed by Dr. Brady for a species of *Lichomolgus* (*L. arenicolus*), but as it has lapsed for that species, it may stand for the above. In suggesting it, I was quite unaware that it had been already employed).

Fam. CYCLOPIDÆ.

Genus **Thorellia,** *Boeck.*

Body expanded in front, tapering posteriorly. Anterior antennæ many-jointed, much shorter than cephalothorax; posterior pair 4-jointed, without a secondary branch. Mandibles dilated at the extremity; palp tubercular, bearing two filaments. Maxillæ bearing several strong apical teeth and marginal setæ. First pair of footjaws 4-jointed, slender, armed with long marginal spines and setæ. Second pair 4-jointed, prehensile, terminating in two hooked claws. First four pairs of feet 2-branched, each branch 3-jointed. Fifth pair rudimentary, reduced to a single branch.

1. *Thorellia brunnea*, Boeck, var. *antarctica*. Pl. V., figs. 15–19.

Cephalothorax as broad as long, rounded in front; rostrum short, obtuse. Segments of thorax rounded at the sides, much broader than long; abdomen very long and narrow. Anterior antennæ about two-thirds as long as cephalothorax, 21-jointed, first joint the largest, as broad as long, next 8 much broader than long, 11th to 19th about as broad as long, 20th longer, and last about twice as long as broad; the first about three times as broad as the last; setæ numerous on the first nine joints. Posterior antennæ 4-jointed, about half as long as the anterior pair. Mandible with numerous teeth on the dilated apex. Anterior footjaws 4-jointed, bearing numerous curved spines and setæ; 3rd joint with a branched appendage. First four pairs of feet furnished with peculiar lancet-shaped spines on the outer margins and extremities; fifth pair with a minute basal joint; second joint elongated, with one lateral and two terminal spines. Caudal setæ densely plumose; middle one as long as the abdomen; outer about three-fourths as long.

Colour—semi-transparent, except the caudal segments which are tinged with dark red. Length (including caudal setæ) $\frac{1}{17}$ inch.

Hab. Dredged in Otago Harbour in 7 fathoms.

This differs from the figure of *Thorellia brunnea* in Brady's Monograph (vol. i., pl. 16) in a few immaterial points. The anterior antenna is not so continuously setose throughout its length, and the fifth pair of feet has three long simple spines, in place of the lancet-shaped spines figured by Brady. In all other respects, except colour (which is a varying feature of no value in this species), our form agrees with the common European one.

Genus **Cyclops**, *Müller.*

Anterior antennæ forming hinged clasping organs in the male. Posterior antennæ 4-jointed, without a secondary branch. Mandible dilated and toothed at the extremity, palp minute bearing two long setæ. Maxillæ strongly toothed. Swimming-feet with both branches 3-jointed.*

a.—Anterior antennæ 17-jointed.

1. *Cyclops gigas*, Claus. Pl. IX., figs. 8–10.

C. gigas, Claus. Die freilebenden Copepoden (1863), p. 100.

Anterior antennæ reaching to third segment of the body, tapering in width somewhat uniformly, relative length of joints as follows :—

1,	2,	3,	4,	5,	6,	7,	8,	9,	10,	11,	12,	13,	14,	15,	16,	17
16.	15.	3.	8.	5.	3.	6.	3.	3.	3.	4.	4.	3.	4.	5.	8.	8.

last joint terminated by about six setæ. Posterior antennæ strongly developed. Mandibles strongly toothed. Setæ of the swimming feet densely plumose; spines pectinately toothed. Fifth foot 2-jointed; basal joint broad, bearing a single long seta at the outer angle; second joint longer, narrow, with a long and a short seta. Abdominal segments pectinately toothed on their posterior margins. Caudal segments about 8 times as long as broad, slightly exceeding in length the three preceding abdominal segments. Central caudal setæ longer than abdomen; outer three-fourths the length of central; inner very short. Length $\frac{1}{10}$ inch.

Hab. Tomahawk Lagoon, near Dunedin.

Our form agrees in all respects with the European species, and the description is almost a reproduction of that in Brady's Monograph, vol i., p. 105.

β.—Anterior antennæ 14-jointed.

2. *Cyclops novæ-zealandiæ*, G. M. Thomson. (Trans. N.Z. Inst., vol. xi., p. 258.)

Numerous specimens (all males) were sent to me from Canterbury by Mr. Charles Chilton.

γ.—Anterior antennæ 12-jointed.

3. *Cyclops serrulatus*, Fischer. Pl. XI., figs. 19–22.

Cephalothorax oval, not greatly exceeding in length the rather slender abdomen. Anterior antennæ reaching to the middle of third body segment, tapering gradually to the extremity; the relative lengths of the joints being about as follows :—

1,	2,	3,	4,	5,	6,	7,	8,	9,	10,	11,	12,
20.	7.	5.	12.	8.	5.	10.	16.	13.	17.	23.	22

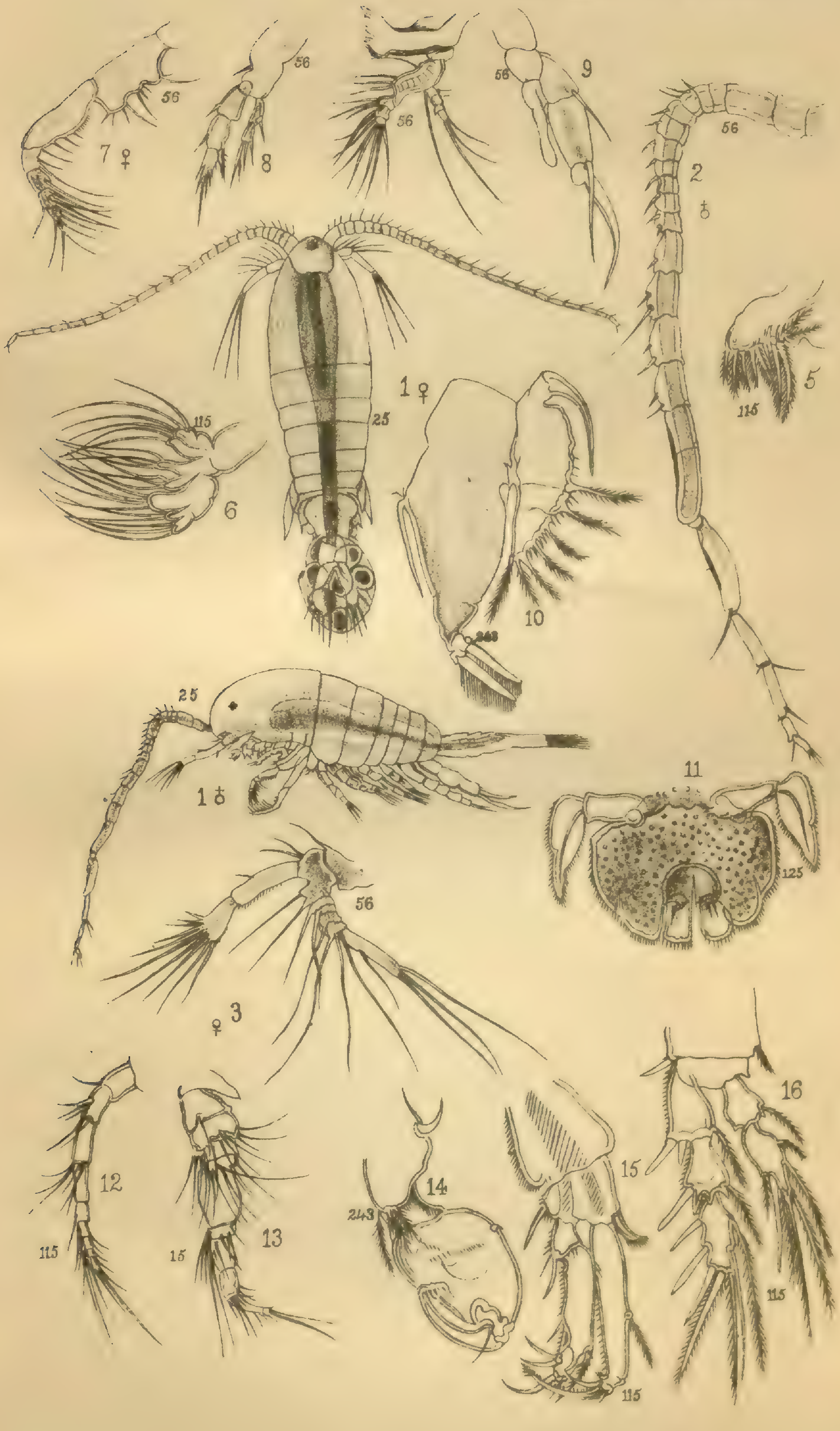
Fifth pair of feet very small, 1-jointed, subtriangular, dilated outwards, bearing 2 setæ and a ciliated lancet-shaped spine. Caudal segments much

* See "Trans. N.Z. Inst.," vol. xi., p. 258.

N. Z. COPEPODA.

G.M.Thomson. del.

J.B. lith.



N. Z. COPEPODA.

G. M. Thomson, del.

J.B. lith.

(4 to 6 times) longer than broad, about as long as two last abdominal segments; outer margin fringed with a row of fine teeth. Innermost tail setæ considerably longer than abdomen.

Length $\frac{1}{20}$ of an inch.

Hab. Tomahawk lagoon, near Dunedin.

My specimens are rather larger than the European form, but in all points of structure agree closely with Dr. Brady's description and figures.

δ.—*Anterior antennæ* 8-*jointed.*

4. *Cyclops chiltoni*, n. sp. Pl. IX., figs. 11–19.

Cephalothorax narrow-oblong in form, last segment hardly wider than abdomen; first segment three-fifths of the length of the whole; rostrum very short. Abdomen slender, subequal with cephalothorax in length, segments about as broad as long, surrounded by rings of minute comb-like teeth. Anterior antennæ three-fourths as long as the first segment of the body, rather stout, joints tapering to the extremity, first about four times as broad as the last; relative lengths as follows:—

$$\frac{1,\quad 2,\quad 3,\quad 4,\quad 5,\quad 6,\quad 7,\quad 8,}{18.\quad 10.\quad 7.\quad 16.\quad 7.\quad 6.\quad 11.\quad 10.};$$

setæ tolerably numerous on the first four joints, last joint with 4 (sometimes 5 or 6, some very small) terminal setæ. Posterior antennæ large; the long seta on the basal joint almost smooth. Mouth organs very small. First four pairs of legs with strong spines. Fifth foot very small, 1-jointed (?), bearing 3 spines, the lower one of which is plumose. Caudal segments about 3 times as long as broad; central caudal setæ three-fourths as long as abdomen. Length, $\frac{1}{18}$ inch.

Hab. Numerous specimens obtained in gravel pits at Eyreton, by Mr. C. Chilton, after whom I have named it.

Quite distinct from the two other species characterized by the 8-jointed anterior antennæ, viz., *C. crassicornis*, Müller, and *C. magniceps*, Lilljeborg.

ε.—*Anterior antennæ* 6-*jointed.*

5. *Cyclops æquoreus*, Fischer. Pl. XI., figs. 16–18.

Body gradually attenuated from before backwards. Anterior antennæ much shorter than first segment of thorax, stout at the base, and only slightly tapering towards the apex; 1st and 2nd joints stout, subequal, 3rd short, 4th the longest, 5th short, 6th about twice as long as 5th; the following represents the relative lengths of the joints in the majority of my specimens (females) $\frac{1,\ 2,\ 3,\ 4,\ 5,\ 6.}{10.\ 10.\ 5.\ 16.\ 7.\ 11.}$ Mandibles dilated at the apex and divided into several slender sharp teeth. Maxillæ strongly toothed. Feet of the 1st pair short, and furnished with rather short setæ. Fifth feet bearing a triangular joint, dilated towards the extremity, and furnished with 3

spines and a short seta. Abdomen slender, first joint about equal in length to the two following: last segment much shorter than preceding; caudal segments nearly as broad as long. Longest caudal seta equalling the abdomen in length; outer and inner very short. Length, $\frac{1}{33}$ of an inch.

Hab. Tomahawk Lagoon, near Dunedin (several specimens).

The above description is almost that of Dr. Brady; my specimens differ from his in hardly any respect but the form of the caudal forks. Any other differences are unimportant.

Fam. HARPACTICIDÆ.

Sub-fam. AMYMOMINÆ.

Genus **Amymome,** *Claus.*

"Body much compressed. Dorsal margin very convex. Head and last thoracic segment very large, produced ventrally and approximating so as to give a more or less circular outline to the animal. Abdomen very short. Head united with the first thoracic segment. First pair of antennæ elongated, 6- or 8-jointed; second pair 3-jointed, and bearing a small 1- or 2-jointed secondary branch, last joint clawed. Mandible palp 1-branched; maxillar palp elongated, 2-jointed. First foot-jaw slender, 3-jointed; second much elongated, 2-jointed, and forming a strong grasping hand. First pair of feet not prehensile, 2-branched, each branch consisting of a single joint; second, third, and fourth pairs with both branches 3-jointed. Fifth foot in the female composed of two, in the male of one, joint. Integument excessively tough and coriaceous, usually cellular or areolated."

The animals forming this genus differ from all others of the family to which they belong in being laterally compressed. In fact their appearance is so remarkable that, until their structure is examined in detail, their affinities would never be suspected. Other prominent characteristics of the genus are the relatively large posterior foot-jaws, and the strongly-marked punctations of the integument. The occurrence of the genus in these seas is very interesting, as hitherto it has not been observed, as Brady remarks, outside the European area.

1. *A. clausii,* n. sp. Pl. V., fig. 1.

First segment of body greatly produced downwards and posteriorly to an almost acute point on each side; four succeeding thoracic segments only about one-fourth the depth of the first, and together hardly exceeding it in length; two anterior abdominal segments large, produced downwards, the first forming a wide expansion, which nearly meets the first body segment, the second ending in an obtuse point; remaining abdominal segments very much abbreviated; caudal setæ minute. Eye large, very difficult to distinguish satisfactorily. Anterior antennæ 6-jointed, about as long as the first segment of the body; first and second joints subequal, third about half

as long, remainder short; all more or less setose. Posterior antennæ about two-thirds as long as the anterior, slender, 3-jointed, terminating in long claw, somewhat like an elongated fourth joint; setæ few. Mandible tout, strongly toothed; palp 2-jointed, with two setæ at the articulation of the second joint, and three at its extremity. Maxillæ (?) not satisfactorily made out. First pair of foot-jaws 3-jointed, rather stout, last joint 2-branched, each branch furnished with several setæ. Second foot-jaws very long, terminating in a powerful chelate hand, which is directed forward; this hand is articulated almost at right-angles with the previous joint, and is furnished at its lower proximal end with 5 comb-like teeth; palm minutely serrated; claw as long as the hand, strongly curved. First pair of thoracic feet shorter than succeeding pairs; branches 1-jointed, furnished with setæ of nearly equal length with themselves; three succeeding pairs long and slender, branches 3-jointed, ciliated on their anterior margins, furnished posteriorly with long somewhat plumose setæ; last pair with the inner branch considerably distended. Fifth pair (?) 1-jointed, conical, terminating in a single seta. Length, $\frac{1}{50}$ inch.

Colour—pale brown; integument closely punctated, particularly on the cephalic and dorsal portions.

Hab. Numerous specimens were obtained by the dredge in Otago Harbour in about 5 fathoms.

This species cannot be mistaken for any other hitherto described; it is nearest *A. spherica*, Claus, but is sufficiently distinguished by the remarkable form of its abdominal segments, by the 6-jointed anterior antennæ, and by the form of the chelate hand of the second pair of foot-jaws.

Sub-family CANTHOCAMPTINEÆ, *Brady*.

Genus **Diarthrodes**, n. gen.

Anterior antennæ 9-jointed; secondary branch of the posterior antennæ 1-jointed. Mandible-palp simple 2-jointed. Second foot-jaw forming a prehensile clawed hand. Outer branch of the first foot very short, 2-jointed; inner branch 3-jointed, the first joint greatly elongated, second and third very short; second, third, and fourth pairs of feet with both branches 3-jointed; fifth pair 2-jointed.

1. *Diarthrodes novæ-zealandiæ*, n. sp. Pl. VIII., figs. 15–22.

Body somewhat tumid; abdomen much narrower than cephalothorax. Anterior antennæ tapering, rather densely setose, the relative lengths of the joints being as follows:—

1,	2,	3,	4,	5,	6,	7,	8,	9.
16.	16.	12.	10.	5.	6.	6.	7.	4.

Posterior antennæ 2-jointed; last joint bearing five terminal and two small lateral setæ; basal joint with a small 1-jointed appendage bearing

three setæ. Mandible rather stout, palp 2-jointed, last joint small with 4 terminal setæ. Anterior foot-jaw terminating in two rather feeble parallel claws. Posterior foot-jaw 2-jointed, terminated by a long, narrow, curved claw. Inner branch of first feet with a long slender basal joint, with a few comb-like spines at the extremity of its outer margin, second and third joints coalescent, short, terminated by a long, straight, slender claw; outer branch with a strong spine on the basal, and four on the terminal joint. Three following pairs of feet somewhat similar, with both branches 3-jointed; outer branch the longest, furnished with stronger spines and setæ than the inner. Fifth pair of feet with the basal joint much dilated, and bearing six setæ on its truncated extremity; second joint small, with five setæ. Caudal segments short and broad; inner tail setæ longer than abdomen; outer about one-fourth shorter than inner. Length, $\frac{1}{80}$ of an inch.

Hab. Otago Harbour, dredged in 7 fathoms among kelp.

Genus **Merope**, n. gen.

Body slender, elongated, posterior margins of the segments fringed with fine teeth; abdomen only slightly narrower than thorax. Anterior antennæ short, few-jointed. Posterior antennæ without a secondary branch. Mouth organs (?). Anterior foot-jaws small, with several digitiform processes; posterior pair forming a slender clawed hand. First pair of feet with both branches 3-jointed; middle joint of inner branch very long, terminal joint bearing two slender claws; next three pairs with the inner branch formed of one joint, bearing two slender setæ. Fifth pair as long as preceding, 2-jointed.

This genus approaches very near *Cletodes* (Brady), but differs in the structure of all the swimming legs. I advance it only provisionally however, as it has been founded on the examination of a single specimen.

1. *Merope hamata*, n. sp. Pl. X., figs. 22–27.

Body about five times as long as broad, much constricted between each segment. First segment (cephalo-thoracic) about three times as long as succeeding ones, front almost truncate, posterior margins produced into hook-like wings. Anterior antennæ 6-jointed, rather stout, not so long as first segment of body, sparingly setose, second joint longest and stoutest; posterior pair rather long and slender. Inner branch of first pair of feet, with the basal joint minute, middle joint very long and unarmed, terminal short and slender; outer branch only about one-third as long as inner, joints subequal, last bearing five geniculate setæ. Outer branch of next three pairs normal, inner very short in second pair, about twice as long in fourth. Fifth pair strongly curved, the basal joint bearing two branches, one normal, foliaceous, bearing about 6 marginal and terminal setæ, the

other rudimentary, 1-jointed, with a single terminal seta. The caudal segments are short, and the setæ single, hardly longer than their segments. The general colour of the animal was a rather deep shade of pink, which was most pronounced at the sides of the segments. Length, $\frac{1}{60}$ of an inch.

Hab. A single specimen taken by the dredge in Dunedin Harbour.

Genus **Laophonte**, *Philippi.*

Body slender, elongated; posterior margins of the segments usually pectinately toothed. Anterior antennæ 4–8-jointed; posterior pair with a small 1-jointed secondary branch. Mandibles with a small 1-jointed palp; maxillæ with a well-developed digitate palp. Anterior foot-jaws strong, with several marginal digitiform processes; posterior pair forming a clawed hand. Feet of 1st pair with the outer branch short, 2- or 3-jointed, and with few, feeble setæ; inner branch 2-jointed, first joint very long, second short and terminating in a long movable claw. Next three pairs with the outer branch 3-, the inner 2-jointed (more rarely 3-jointed). Fifth pair 2-jointed, basal joint largest.

1. *Laophonte australasica*, n. sp. Pl. XI., figs. 1–10.

Female.—Body slender, segment rings showing the characteristic tooth-like margins only faintly. Anterior antennæ short, 4-jointed, furnished with numerous short setæ, and an auditory seta at the extremity of the 3rd joint. Posterior antennæ stout, 2-jointed; basal joint bearing a 1-jointed secondary branch furnished with 4 setæ, terminal joint having 4 stout curved marginal spines and 3 setæ, which are finely annulated towards their extremities. Mandibles, maxillæ, and foot-jaws normally developed. Feet of the 1st pair with the inner branch greatly elongated, second joint short and ciliated on its outer face, claw long and strong; outer branch with three nearly equal joints, each bearing a marginal spine near its distal end, and the last having in addition 3 terminal setæ. Three following pairs of feet with the outer branches stout, 3-jointed, and strongly spined, inner branches much shorter, 2-jointed (probably 3-jointed, but the basal joint is nearly quite anchylosed in the peduncle), last joint with 3 long feeble setæ. Fifth pair of feet with the second joint quadrangular, bearing about 5 terminal setæ. Caudal segments only about half as long as last abdominal segment; setæ not quite half as long as abdomen. Length $\frac{1}{45}$ of an inch.

Hab. Two specimens (both females) taken by the dredge in Dunedin Harbour.

This may be *L.* (*Cleta*) *forcipata*, Claus (Die Copepoden Fauna von Nizza, p. 23, taf. II., figs. 9–11), but Dr. Claus has given so short and incomplete a description, and has besides only described and figured males, that identification is not possible until the male of our species has been obtained.

Sub-fam. Harpactineæ.

Genus **Dactylopus**, *Claus.*

Body elongated, cylindrical. Anterior antennæ 5–9-jointed, geniculate in the male; posterior pair with a rather small 2– 3-jointed secondary branch. Mandible-palp composed of a basal joint, with two 1-jointed branches. Posterior foot-jaws forming a clawed hand. Four anterior pairs of legs with both branches 3-jointed; first pair having the inner branch elongated, first joint very long, second and third very short, and ending in two claws, outer branch shorter, ending in four claws; fifth pair 2-jointed, foliaceous.

1. *D. tisboides*, Claus. (Die frei lebenden Copepoden, p. 127; taf. xvi., figs. 24–28.

Rostrum short and conical. Anterior antennæ 8-jointed (9-jointed, *Brady*), tapering from the base in the female, bearing numerous setæ. Inner branch of posterior antennæ 3-jointed. Posterior foot-jaw with an elongate-oval hand, with a single long seta near the middle of its inner margin. Outer margins of both branches of the first pair of feet with pectinate setæ; inner branch with the first joint longer than the whole outer branch, bearing a long plumose seta on the inner margin; outer branch with the middle joint thrice as long as the first or third, ciliated on both margins, and with the cilia of the outer margin usually strong and spinous. Next three pairs of feet have the branches nearly equal, bearing long plumose setæ, and ciliated on the external margins; the second pair in the male has the second and third joints coalescent, the outer margin excavated above and below the middle, and bearing one large crooked spine and several strong short setæ, and at the apex two stunted spines, the inner margin bears three setæ two of them very long and plumose. Fifth foot having both joints subequal, broadly ovate, and bearing several rather long apical setæ. Caudal segments short; inner caudal setæ about two-thirds as long as body. Length, $\frac{1}{25}$ of an inch ($\frac{1}{45}$ *Brady*).

The above description, which is chiefly taken from Brady's Monograph (Brit. Cop., vol. ii., p. 106), agrees very closely with the form commones here, except in size.

I have also got a second form, which for convenience may be termed var. *a*, differing in some respects. The anterior antennæ have the first four joints stout and broad; the foot-jaws with the hand stout, wanting the seta on the inner margin, but bearing a short, curved, plumose spine on the wrist; the inner branch of the first pair of feet destitute of the long seta on its inner margin; and the fifth pair of feet with the outer joint broad, and only bearing five setæ.

Hab. Both forms occur in Dunedin Harbour, the normal type most abundantly; in shore kelp.

Genus **Xouthous**, *n. gen.*

Body conical, rounded in front. Anterior antennæ 7-jointed, geniculate in the male; posterior pair with a small 3-jointed secondary branch. Mandibles with a large 2-branched palp. Anterior foot-jaws small, posterior rather large and bearing an elongated claw. First pair of feet with the inner branch 2-jointed; outer 3-jointed. Next three pairs with both branches 3-jointed; fifth pair 2-jointed.

Perhaps this genus should only rank as a sub-genus of *Dactylopus*, to which it is most nearly allied, but besides being very different in its general appearance, it differs in the structure of the mandibles, and of the first and fifth pairs of feet.

1. *Xouthous novæ-zealandiæ*, n. sp. Pl. X., figs. 8–15.

Body rather short, narrowing posteriorily; abdomen not very distinctly separated from thorax. When seen laterally, the body is flat on the ventral, but convexly arched along the dorsal surface. Head merged with first segment of thorax. The integument is very dense and opaque, except at two spots in the front of the thorax, where it becomes diaphanous, and presents the appearance of two lateral eyes. A red spot at each of these lateral eye-spots probably marks a rudimentary eye, while the median eye appears to be wanting: if present, it would be useless, on account of the opacity of the carapace. The anterior antennæ are much shorter than the cephalothorax and lie in a groove on its under surface; in the *male* they are strongly geniculated and swollen, and the terminal joints act like an opposable thumb or claw; in the *female*, they are stout at the base and taper to the extremity.

The posterior antennæ are strongly developed, as large as the anterior, and bear a small, 3-jointed, secondary branch, which is terminated by two long slender setæ. Mandible-palp forming a two-branched appendage, the larger branch bearing two stout plumose spines and two terminal setæ. Maxillæ small, (?) palp apparently slender, and bearing two long setæ. Anterior foot-jaws small, bearing several marginal setose processes. Posterior pair 2-jointed, terminated by a strong claw; basal joint with a strong spine. First pair of feet with inner branch elongated, 2-jointed, first joint large, broad at the base and bearing a very long seta, second very short and narrow, carrying two long setæ, which are jointed near their apex; outer branch 3-jointed, considerably shorter than first joint of inner. Second and third pairs of feet with both branches 3-jointed, inner branch the longer, the individual joints broader and less setose than those of the outer. Fourth pair of feet with both branches 3-jointed, subequal. Fifth pair 2-branched, outer branch 2-jointed (?), terminal joint bearing five subterminal spine-like setæ; inner branch subquadrate, with five setæ on its lower margin: similar in both sexes. Caudal setæ very short.

Integument very strong, smooth, opaque-brown in colour. Length, $\frac{1}{48}$ of an inch. Ovisac single.

Hab. Dredged in Dunedin Harbour; not rare, but easily overlooked on account of its colour.

Genus **Thalestris,** *Claus.*

Body usually slender and elongated. Anterior antennæ 8- or 9-jointed; inner branch of posterior pair 2- or 3-jointed. Mandible-palp large, 2-branched. Maxillæ strongly toothed, palp usually terminated by a large claw. Anterior foot-jaws ending in a strong claw, and bearing several setiferous marginal processes. Posterior pair forming a strong prehensile hand. First pair of feet with both branches 3-jointed, and furnished at the extremities with strong prehensile claws; first joint of inner branch much elongated, second and third very short; first and third joints of outer branch short, middle greatly elongated. Second pair in the male have the third joint of the inner branch wanting or very much reduced in size, and converted into two or three strong spines. Fifth pair of feet 2-branched, foliaceous; much reduced in size in the males. Ovisac single.

1. *T. forficula*, Claus. Pl. X., figs. 16–21.

(*Thalestris forficula*, Claus. Die frei lebenden Copepoden, p. 131, taf. xvii., figs. 7-11).

Body rather slender; abdomen long, narrowing very gradually, posterior margins of the segments pectinated with rather long teeth; rostrum acute, of moderate length. Anterior antennæ 8-jointed; in the female tapering gradually, and furnished with numerous setæ, the basal joint about four times as broad as the apical, fourth joint bearing a long auditory seta; in the male the joints are irregularly swollen and bent. Posterior antennæ rather strongly spined on the lower margin; secondary branch small, 2-jointed, and bearing 4 setæ. The posterior foot-jaws have a short basal joint, and a rather stout hand, furnished with a single long seta in the middle of the inner margin; terminal claw long and slender. First pair of feet with both branches long and slender; the outer, which is much the longer of the two, has the basal joints greatly elongated, and the second and third very short and apparently anchylosed, the basal joint bears a single rather short seta on the inner margin above the middle, while the terminal joint carries two nearly straight claws of unequal length; inner branch with the middle joint very long, toothed along the outer margin, terminal joint bearing four slightly curved and toothed claws. Feet of fifth pair with the outer joint large and oval in the female, and extending to half the length of the abdomen. Caudal forks short, and somewhat divergent. Central caudal setæ nearly as long as body, swollen just beyond their basal articulation, and marked along the greater part of their length with annular articulations; outer setæ about half as long as inner and lying very close to it. Length, $\frac{1}{25}$ of an inch.

N. Z. COPEPODA.

G. M. Thomson, del.

J.B. lith.

N. Z. COPEPODA.

G. M. Thomson, del.

J. B. lith.

Hab. Taken abundantly with the dredge in Dunedin Harbour.

This species was originally described by Dr. Claus from the Mediterranean (Messina); the specific name refers to the scissor-like appearance of the caudal forks and setæ. The European specimens appear to be smaller than ours, being only 0·8 mm. ($\frac{1}{32}$ of an inch) in length, but in other respects are very similar.

Genus **Harpacticus,** *Milne-Edwards.*

"Body elongated, or broad and depressed. Head united with the first thoracic segment; first and second abdominal rings coalescent in the *female.* Anterior antennæ 8- or 9-jointed; fifth and sixth joints swollen in the *male.* Mandible-palp 2-branched, large. Posterior foot-jaws strongly developed. First pair of feet with outer branch 3-jointed, first and second joints elongated, third rudimentary; inner branch 2-jointed, terminal joint very short. Three following pairs of feet with both branches 3-jointed; in the male, the inner branch of the second pair modified by having the 2nd joint produced into one or more spines, while in the third foot the outer branch is converted into a stout clasping organ, which is bent across the inner branch, and has its last joint armed with several strong spines. Ovisac single.

1. *Harpacticus chelifer,* Müller. Pl. VI., figs. 12–16.

(*Arpacticus bairdii,* mihi, Trans. N.Z. Inst., vol. xi., p. 259.)

In the description already given of this species I have made one or two errors, which in the absence of a clear description of *H. chelifer,* led me to consider my specimens to belong to a new species. The anterior antennæ are 9- (not 10-jointed), and the relative length of the joints (in the female) is as follows:—

1,	2,	3,	4,	5,	6,	7,	8,	9,
11.	18.	20.	20.	7.	8.	4.	3.	4.

In the male, the anterior antennæ are hinged between the fourth and fifth joints, the fifth and sixth being swollen and corrugated. The hand of the posterior foot-jaw is subtriangular, and externally very convex, its inner margin being somewhat abruptly angled, strongly excavate and furnished with numerous spines; its apex bears one (or two) falciform claws.

The first pair of feet have the inner branch 2- (not 3-) jointed, and terminating in two claws. The second foot in the male has the median joint of its inner branch externally produced into a long spine, which greatly exceeds in size the small third joint. The outer branch of the third foot in the male is furnished with three strong spines at its apex, and is bent across the inner branch. In the fifth foot of the male, the basal joint is obsolete.

This species is common in the European seas, and is by far the most abundant of our littoral Copepods.

It occurs in Dunedin Harbour, in rock pools along the beach from Otago Heads to Taieri Mouth; and I have specimens from Paterson Inlet.

Genus **Zaus**, *Goodsir.*

Body broad and depressed; head distinct from cephalothorax; rostrum broad and truncate. Anterior antennæ 9-jointed; posterior 2-jointed, with remarkable comb-like spines at the apex, inner branch slender, 2-jointed. Mandible small, palp slender, 2-branched, second foot-jaws strongly clawed. First pair of feet 2-branched; outer branch indistinctly 3-jointed, the median joint very short; inner branch 2-jointed, short, last joint rudimentary. Ovisac large, single.

1. *Zaus contractus*, n. sp. Pl. X., figs. 1–7.

Body oblong, not much narrowed posteriorly. Cephalothorax nearly half as long as body, rounded in front; rostrum short, blunt. Abdomen less than one-fourth as long as body, broader than long. Anterior antennæ short, tapering gradually; joints having the following relative lengths:—

1,	2,	3,	4,	5,	6,	7,	8,	9,
10.	14.	14.	8.	3.	4.	2.	2.	3.

Posterior antennæ 2-jointed; first joint broad, bearing internally a 2-jointed appendage and a single seta externally; second joint elongated and furnished with two or three curved setæ, and two curved plate-like organs pectinated on their outer margin; (one of the setæ, which is jointed near its apex, appears to act as an opposable clasping organ). Mandibles small, bearing a 2-branched palp. Maxillæ very small. Anterior foot-jaws small, normally formed; posterior with an ovate or somewhat pyriform hand and a strongly curved claw, which impinges against a deep groove in the palm of the hand. First pair of feet with the outer branch elongated, apparently only two-jointed (from the coalescence of two of the joints ?); first joint pectinately setose on its outer margin, terminating in a single seta; second joint ending in four curved blunt claws, furnished with comb-like teeth: inner branch little more than half as long as outer, 2-jointed; first joint pectinate-spinose on the outer margin; second joint very small, bearing a strong curved claw, minutely toothed on its inner margin. Three following pairs of feet 2-branched, each branch 3-jointed, rather slender; outer branches strongly spined on the outer margin and apex, spines furnished with pectinated plates or flanges on their outer (upper) margins. Fifth pair with each branch 1-jointed, inner branch rounded and bearing four marginal (terminal) setæ, outer rather longer, and also furnished with four setæ. Posterior abdominal segments shortly spined at their postero-lateral margins; caudal segments nearly square; caudal setæ short.

Length $\frac{1}{40}$ of an inch.

Hab. Dredged in Otago Harbour; 5 fathoms.

Sub-family Porcellidiinæ.

Genus **Porcellidium,** *Claus.*

"Body oval, depressed, in the female 6-, in the male 7-jointed. Anterior antennæ 6-jointed, in the male obtuse, knotted, and adapted for clasping; posterior 4-jointed, secondary branch of moderate size, 1-jointed, attached to apex of second joint. Mandibular-palp large, forming an irregularly-shaped oblong lamina, beset with numerous stout ciliated filaments. Maxilla composed of a toothed masticatory branch, with a complex 4-digitate palp. Anterior foot-jaw not forming a prehensile hand, divided at the apex into short digits, which bear slender, terminal, claw-like setæ; posterior foot-jaw 3-jointed, elongated, simple, with two small, crooked, apical claws, and a laminar appendage. Outer branch of first pair of feet short, 3-jointed; inner branch composed of one excessively broad triangular joint, which is clawed at the apex, claws bearing delicate laminar expansions. Second third and fourth pairs with both branches 3-jointed, branches subequal, except in the second pair, which has the outer branch very short; fifth pair laminar, subtriangular; caudal segments lamellar."

1. *Porcellidium fulvum*, n. sp. Pl. VI., figs. 10–11; Pl. VII., figs. 8–13.

Female.—Body nearly a perfect oval, hardly more than half as long as broad, rounded both anteriorly and posteriorly. Anterior antennæ very short, in length not equalling half the width of the body, 6-jointed; joints diminishing in size progressively, last very small; setæ numerous. Feet of first pair with the inner branch forming an elongated triangle, the terminal claws long and straight. Fifth pair of feet subtriangular, acute at apex, falcate in outline (when seen from above), with a longitudinal crest or ridge; caudal segments quadrate, ciliated at the extremity. Length $\frac{1}{20}$ inch.

Male.—Body proportionately much broader, nearly square in front, and narrowed posteriorly. Anterior antennæ (apparently 6-jointed) greatly swollen and knotted. Fifth pair of feet subquadrate, curved, widely expanded at the extremity and fringed with (about 6) sharp spines; caudal setæ as in female. Length $\frac{1}{31}$ inch.

The two sexes are so different in general form that they might almost be taken at first for distinct species; the specimens however from which the figures were taken were in the act of copulation when captured. One of the most singular points of difference is their size, the females being in almost all cases half as large again as the males. The integument in this species is thickly marked with circular depressions or pits.

The colour is most commonly a uniform clear yellow, but is sometimes nearly transparent, or banded with red.

Hab. Common on seaweed along the shores of Otago Harbour, and in rock pools, and dredged in the harbour in six fathoms; also collected by Mr. C. Chilton on seaweeds in Lyttelton Harbour.

2. *Porcellidium interruptum*, n. sp. Pl. XI., fig. 15.

Body very broadly oval, width nearly equal to three-fourths of the length; first segment about half as long as body; last thoracic segment produced behind into long pointed lamellæ, which nearly meet posteriorly in the median line behind the caudal segments, the outer margin of each is finely ciliated and produced about the middle into a short spine. Inner branch of the first feet triangular, very broad at the base; outer branch nearly as long as inner. The second pair of feet have the outer branch short, hardly exceeding in length the first joint of the inner branch. Fifth feet form two somewhat curved lamellæ, the inner of which almost extends to the extremity of the caudal segments: these last are rather longer than broad, their sides are nearly parallel, and their posterior margins fringed with a few short teeth. Length, $\frac{1}{45}$ of an inch.

Hab. Two specimens (both females) taken by the dredge in Dunedin Harbour.

This is a very remarkable form and quite different from any hitherto described.

Sub-fam. Idyinæ.

Genus **Idya**, *Philippi*.

Cephalothorax broad and somewhat depressed; abdomen narrow, 5-jointed. Head coalescent with first thoracic segment. Anterior antennæ 7- or 8-jointed, elongated; posterior 3-jointed, with a large 4-jointed secondary branch. Mandible long and strongly toothed; palp 2-branched, basal joint short, branches 1-jointed, long and slender, setiferous at the apices. Maxilla armed with several slender terminal teeth; palp well developed. First and second foot-jaws nearly alike, hooked; first pair 2-, second 3-jointed. Inner branch of the first pair of feet 2-jointed, clawed; outer branch short, 3-jointed; three following pairs with both branches 3-jointed. Fifth pair elongated, 2-jointed. Ovisac single.

1. *Idya furcata*, Baird. Pl. VIII., figs. 1–8.

(For synonymy of this species, see Brady's Mon. Brit. Cop., vol. ii., p. 172.)

Body elongated, somewhat pyriform; rostrum short and obtuse. Anterior antennæ 8-jointed, first four joints much stouter than last four; their comparative length is tabulated by Brady as follows:—

1,	2,	3,	4,	5,	6,	7,	8,
10.	18.	13.	18.	3.	3.	2.	8.

This character is said by Brady, Claus and others to vary considerably, but the following taken from my own specimens shows almost the same relative lengths except in the fourth joint, viz.:—

1,	2,	3,	4,	5,	6,	7,	8,
12.	19.	15.	12.	4.	5.	3.	9.

All the joints are somewhat setose, and the fourth bears a long curved seta (the olfactory appendage?). In the male there is usually a distinct geniculation at the fourth and fifth joints, which are more or less swollen and coalescent. The posterior antennæ are furnished with 5 geniculated setæ at the extremity, and 2 on the inner margin of the terminal joint; the 4-jointed secondary branch is also furnished with a few setæ. Both pairs of foot-jaws slender, second pair the strongest. First pair of feet with the inner branch consisting of two long joints, the first of which is dilated above the middle and bears a plumose seta near its extremity, the second is straight, bears a plumose seta on its inner margin, is pectinately ciliated on its outer margin and terminates in two claws; the outer branch is much shorter, its first joint bears a plumose seta at its apex, the second is furnished with two setæ at the extremity, one of them being similar to the fringed setæ of the terminal joint, third joint very short and bearing six setæ, four of which are somewhat flattened and furnished with terminal fringes of close-set cilia, while the other two are longer and plumose. Three following pairs of feet almost similar, each branch 3-jointed. Fifth pair with a short basal joint, with a seta at each angle of its apex; second joint flattened, ciliated on both margins, and bearing 5 long setæ at its apex. Caudal segments about as long as broad. Brady states that the fourth and fifth abdominal segments are very short, in the specimens examined by me the fourth was very short, but the fifth was very much longer, nearly as long as broad. He also states that "the inner tail-setæ are nearly as long as the body of the animal, outer about half as long, both finely aculeate in their entire length." In the specimen figured by me the inner seta is not much more than half the length of the body, and this proportional length is very general in the individuals examined by me. The animal is usually colourless, or according to Brady also "pale milky-white, often yellowish, and sometimes distinctly banded with pale lilac or purple. Length, $\frac{1}{40}$–$\frac{1}{30}$ inch ($\frac{1}{25}$ in. Brady).

Hab. Common in shore kelp and rock-pools near Dunedin; also on kelp in Paterson Inlet.

An abundant species in European seas: occurring in the littoral and laminarian zones, and often "taken by the tow-net in the open sea."

Genus **Scutellidium**, *Claus.*

Body depressed, subovate. Anterior antennæ 9-jointed, with very short median joints; posterior 3-jointed, the inner branch short, 1- (? 4-) jointed. Mandible palp large and complex, bearing numerous stout setiferous filaments; maxillary palp provided with two very long and stout ciliated setæ. Both pairs of foot-jaws forming clawed hands. First pair of feet

prehensile ; inner branch 2-jointed (or indistinctly 3-jointed), clawed ; outer branch short, 3-jointed. Three following pairs have both branches 3-jointed. Fifth pair foliaceous, the outer branch much elongated. Ovisac single.

1. *Scutellidium tisboides*, Claus. Pl. VII., figs. 1–7.

Scutellidium tisboides, Claus. Die Copepoden-fauna von Nizza, p. 21, taf. iv., figs. 8-15.
Scutellidium tisboides, Brady. Monograph of the Brit. Copepoda, vol. ii., p. 175, pl. lxviii., figs. 1-10.

Cephalothorax broad, rounded in front, first segment one-and-a-half times as broad as long ; the postero-lateral angles of the succeeding short segments somewhat produced backwards ; abdomen narrowed. Anterior antennæ shorter than first segment of body, 9-jointed, and becoming slender towards its apex ; first three segments large, next five much shorter, terminal joint longer and very slender. Foot-jaws short and stout ; last joint of the first pair slender, and bearing two curved apical claws ; hand of the second pair dilated at the base, subpyriform, ending in three strong claws. Both branches of the first pair of feet 3-jointed and thick : the inner branch is much the longest ; the first joint dilated near the base, ciliated on both margins, and bearing about the middle of the inner margin a large plumose cilia ; second joint with a stout short curved seta ; last joint very small, and bearing two flattish blunt appendages, which are thickly fringed on their lower margins with fine cilia : outer branch short ; first joint ciliated externally and furnished with two apical spinous setæ ; second and third joints much shorter, each with one plumose seta ; terminated by four curved obtuse claws. Three following pairs of feet 2-branched, each branch 3-jointed ; external margins of the joints furnished with short stout spines, which are pectinately fringed on their upper margins. Fifth pair of feet 2-jointed, the basal joint marginally ciliated, elongated, and 2-cleft, each lobe terminating in one (or more) long setæ ; second joint much elongated, marginally ciliated. Inner tail-setæ considerably longer than the abdomen. Ovisac large, circular, extending considerably beyond the extremity of the abdomen. Length, $\frac{1}{28}$ inch, exclusive of the caudal setæ.

The foregoing description, taken in part from Brady's Brit. Copepoda, is verified in all the points indicated by my own examinations. In all my specimens the segments of the abdomen were finely pectinated with short setæ on their posterior margins. The following characters given by Brady, I have not been able to identify : "the first abdominal segment is formed by the almost complete union of two segments, the point of junction being marked by a chitinous line on each side. Eye consisting of one central and two lateral lenses."

The anterior antennæ in the male have the third and fourth joints somewhat swollen and bent, a character specified by Claus, though it is not as distinctly shown in his figures as in the specimens examined by me. The secondary branch of the posterior antennæ is stated by Claus to be 4-jointed, while Brady considers it to be 1-jointed, though he admits that in some specimens it appeared to be very indistinctly 4-jointed. I should say the four joints were present, but they can only be made out by a high-power objective of good definition. The terminal joints of these antennæ are furnished with six setæ (of which four are long and geniculated), and two short pectinate spines. The mandibles terminate in four rather blunt apical teeth. There appears to be no essential difference between the fifth pair of feet in either sex; the figures of this organ in both Claus's and Brady's works are slightly different from mine. The same remark applies to a certain extent to the figures of the entire animal, as well as of the first pair of legs, but the differences are so slight, that I have not the slightest doubt of the correct identification of our species with the European one.

Originally described from specimens found at Nice in the Mediterranean; also found (but sparingly) in tide-pools, among *Laminaria*, etc., on the British coasts.

Hab. It occurs abundantly among seaweed, in rock-pools, etc., both in Otago Harbour and along the ocean beach, Dunedin; also on kelp in Paterson Inlet.

Fam. ARTOTROGIDÆ, *Brady.*

Body broad, depressed, rounded or subovate, composed of 10–12 segments, first segment very large, and composed of the coalescent cephalic and first thoracic somites, abdomen short, distinctly separated from the cephalothorax. Anterior antennæ short, 9–20-jointed, alike, or nearly alike in both sexes; posterior short, 3–4-jointed, secondary branch (when present) 1-jointed. Mouth produced into a siphon composed of the elongated labrum and labium; mandibles stilet-shaped, simple or provided with a slender, filiform palp; maxillæ usually 2-branched and setiferous; first and second pairs of foot-jaws simple, prehensile, 2–4-jointed, usually clawed strongly at the apex. First four pairs of feet usually 2-branched, each branch 2- or 3-jointed. Fifth pair small and 1- or 2-jointed, or altogether wanting.

Genus **Conostoma**, *n. gen.*

Body flattened, broadly ovate; abdomen very short. Anterior antennæ few- (about 9-) jointed; posterior 4-jointed, secondary branch wanting. Mouth siphon rather slender and short. Anterior foot-jaws 2-, posterior 4-jointed. Feet of the first pair with both branches only 2-jointed; next three pairs almost similar. Fifth pair rudimentary.

This genus is nearly allied to *Artotrogus*, but differs completely in the structure of all the swimming feet.

1. *Conostoma elliptica*, n. sp. Pl. V., figs. 9–14.

Body broadly elliptical, rounded in front, width more than two-thirds of the length; first segment short, hardly separated from the second, except by a slight lateral constriction, the two together form a broad cephalo-thoracic carapace which is more than two-thirds as long as the whole body; two last thoracic segments much curved inwards posteriorly; abdomen greatly abbreviated, only two segments being apparent. Anterior antennæ rather short; eighth joint the longest, and furnished at its extremity with a long (auditory?) seta; posterior antennæ feeble, bearing one or two terminal setæ. Mouth siphon slightly ciliated at its extremity. Anterior foot-jaws with the basal joint broad, and apparently furnished with a hollow groove on its inner margin to receive the subequal second joint which is curved and sharply pointed at its apex: posterior pair 4-jointed, second joint large, third very short, last ending in a sharp claw, and furnished with two sharp teeth on its inner margin. Swimming legs furnished with numerous rather short plumose setæ. Caudal segments rather broader than long, terminated by 4 plumose setæ, the longest being about one-fourth the length of the body. Length, $\frac{1}{25}$ of an inch.

Hab. Only one specimen of this peculiar form was obtained by the dredge in Otago Harbour.

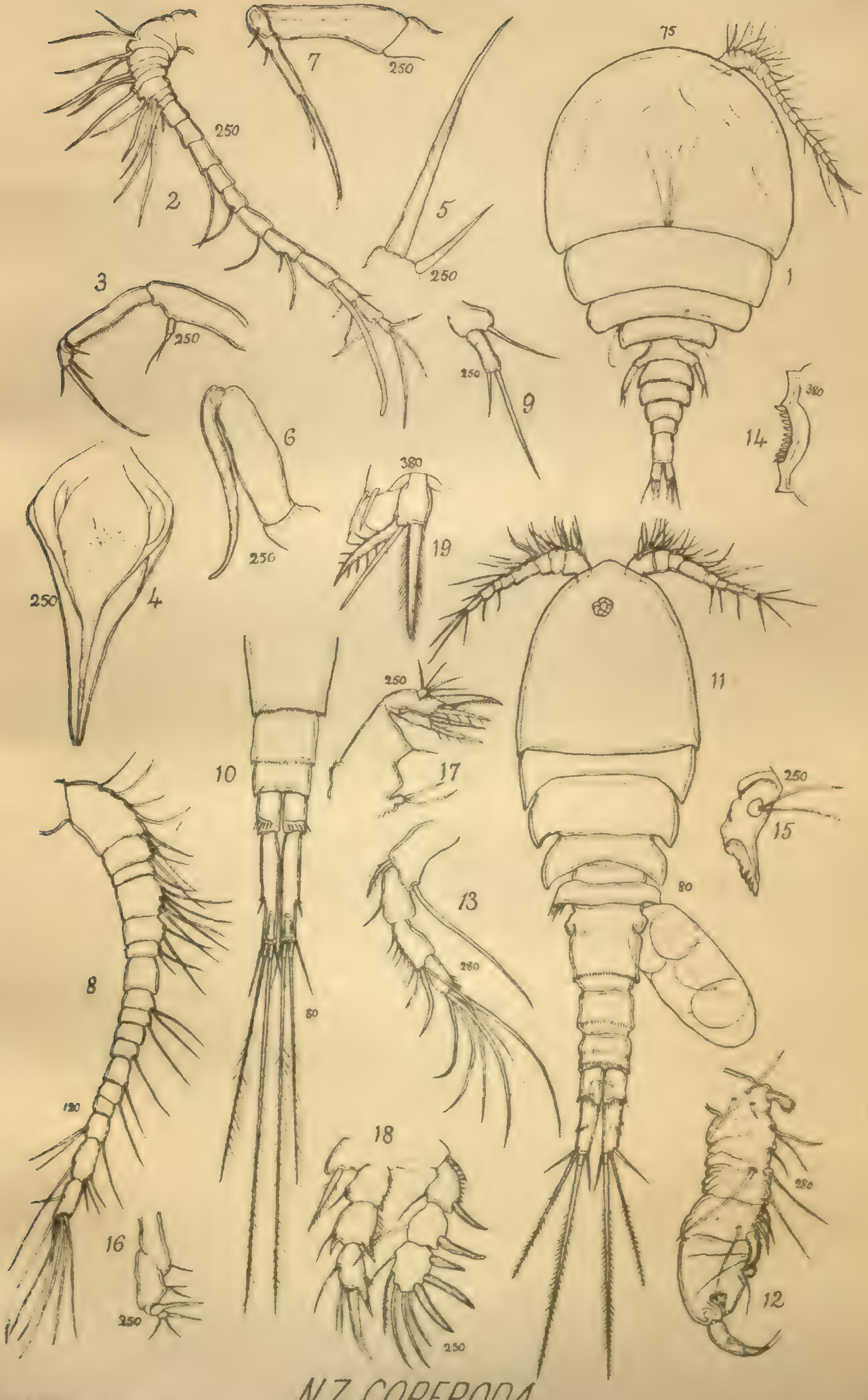
In the figure, two coiled organs are shown near the posterior end of the body; these have been rather prominently brought out by Mr. Buchanan; they are probably cement-glands.

Genus **Artotrogus**, *Boeck.*

Body broad, suborbicular or pyriform; cephalothorax broadly ovate; abdomen of four segments, first and second of which are coalescent in the female. Anterior antennæ 9–20-jointed, shorter than the cephalothorax; posterior 4-jointed, with a strong apical claw, without an appendage or with only a very small one. Mouth produced into a siphon which reaches to about the hinder margin of the first body-segment. Mandibles elongated, filiform, without a palp. Maxillæ 2-branched, setiferous at their apex. Footjaws simple, bearing a strong apical claw on each; first pair 2-jointed; second 4-jointed. First four pairs of feet 2-branched, each branch 3-jointed; fifth pair rudimentary, 1-jointed.

"Animals living in the branchial sacs of simple Ascidians or on the integument of various marine Invertebrata" (Brady).

All my specimens have been obtained by the dredge, apparently swimming freely, or crawling on kelp or on Sertularians.



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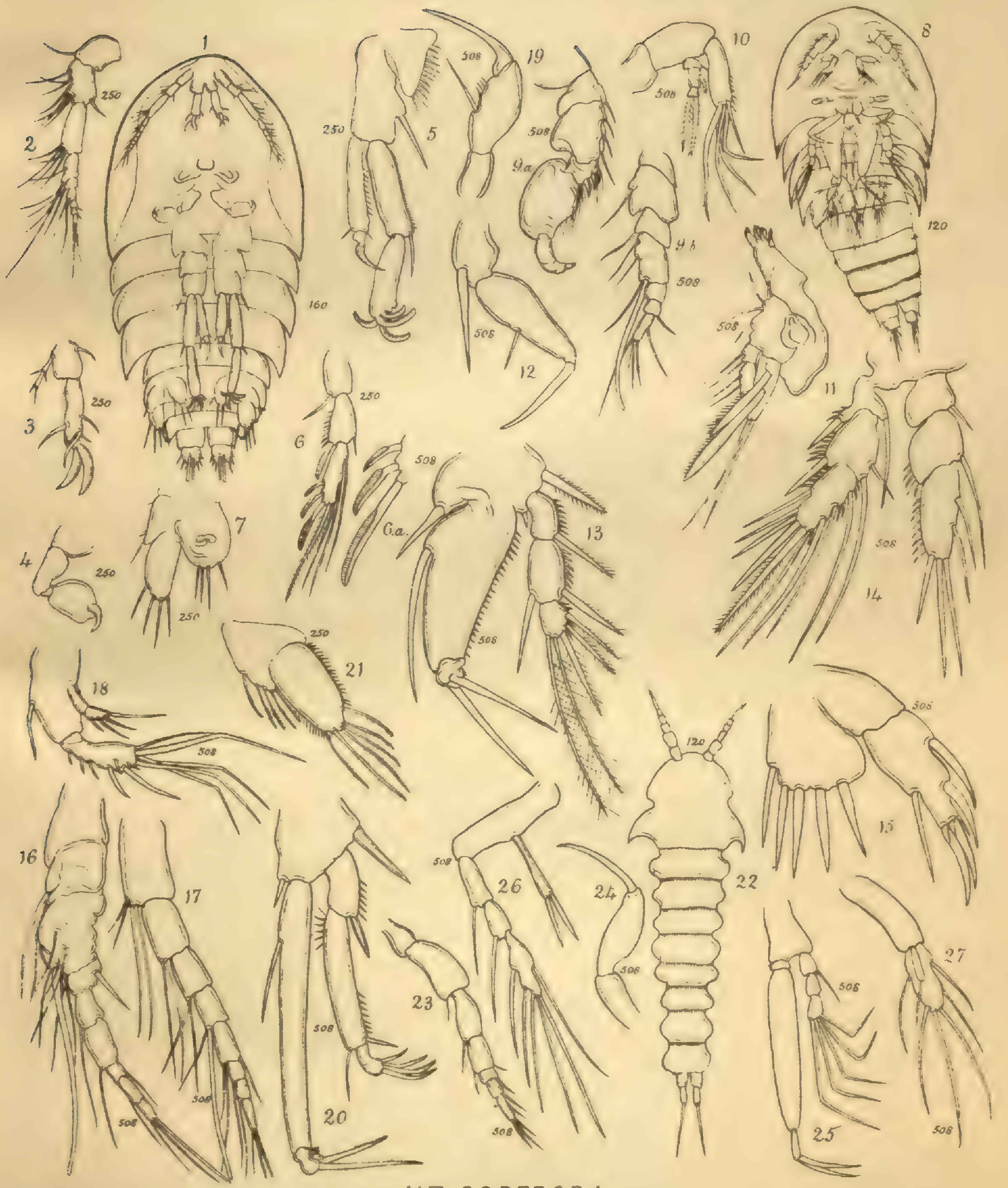

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1. *Artotrogus boeckii*, Brady. Pl. IX., figs. 1–7. (Monogr. Brit. Copepoda, vol. iii., p. 60).

First segment less than a third as long as the whole body; breadth one and a half times its length; succeeding segments very much broader than long. Abdomen short and narrow. Anterior antennæ 20-jointed; first the largest, next eight much broader than long, succeeding joints longer than broad; setæ rather numerous. Posterior antennæ with a small 1-jointed appendage, bearing two small setæ on the second joint. Mandible in the form of a long filiform seta. Siphon lobes very narrow and slender. First four pairs of feet normally formed. Fifth pair ciliated on the margins, furnished with two apical setæ. Caudal segments about as long as broad; middle setæ about as long as abdomen, finely plumose.

Length (including caudal setæ), $\frac{1}{27}$ of an inch.

Hab. Taken (free) with the dredge in Otago Harbour.

Originally taken by M. Thorell from an Ascidian; also obtained, but only two or three specimens, by Dr. Brady, amongst weeds, and by a surface-net in the west of Ireland.

2. *Artotrogus ovatus*, n. sp. Pl. XI., figs. 11–14.

Female.—Body ovoid, first segment twice as long as the three following ones, last thoracic segment very short; abdomen slender, elongated, about half as long as thorax, segments subequal in length. Anterior antennæ short, 8- (? 9-) jointed, furnished with numerous setæ; first and second joints longest, rest subequal; a long auditory seta from extremity of sixth joint. Posterior antennæ with a small 1-jointed secondary branch, terminated by a single long seta; last joint bearing two terminal lance-like spines, and a short sub-terminal seta. Mouth siphon very short, conical. Mandibular seta not reaching to second thoracic segment. Swimming feet with both branches 3-jointed and normally developed. Fifth feet consisting of a very short ovate lobe, with three setæ. Caudal segments nearly as broad as long; setæ all plumose, central rather longer than abdomen, outer about three-fourths as long. Ovisacs two, containing each four rather large ova.

Length, $\frac{1}{26}$ of an inch (exclusive of setæ).

Hab. Two specimens taken on kelp in Paterson Inlet.

Genus **Acontiophorus**, *Brady*.

Body suborbicular or sub-pyriform. Anterior antennæ 11-jointed (or 6-jointed in one species), shorter than the first segment of the cephalothorax; posterior 4-jointed, bearing two lancet-shaped spines at the apex, and with or without a small secondary branch. Mouth produced into a very long slender siphon, which exceeds the cephalothorax in length. Mandible elongated, filiform, without a palp. Maxillæ 2-branched, setiferous at the

apex. First and second pairs of foot-jaws simple, bearing a strong apical claw, first of two, second of four joints. First four pairs of foot having both branches 3-jointed: fifth pair 2-jointed.

1. *Acontiophorus scutatus,* Brady and Robertson. (Monogr. of Brit. Copepoda, vol. iii., p. 69). Pl. VIII., figs 9–14.

The following description is taken from Brady's Monograph, and agrees exactly with our form:—

"Body sub-pyriform; cephalothorax broadly ovate; head united with the first thoracic somite, the segment thus formed being very large and equal to nearly half the entire length of the body; abdomen of the *female* 3-jointed (of the *male* 4-jointed), the first segment large, and composed of two coalescent somites. Posterior angles of all the body-segments rounded off, or only very slightly produced. Anterior antennæ very short, scarcely one-third as long as the first segment of the body, stout at the base, and gradually tapering to the apex, densely clothed on the outer margin and apex with long fine hairs, some of which are plumose; to the seventh joint is attached a long curved olfactory appendage. The relative lengths of the various joints is represented by the following formula:—

1,	2,	3,	4,	5,	6,	7,	8,	9,	10,	11.
9.	7.	2.	1.	2.	5.	2½.	2½.	3.	3.	4.

"Posterior antennæ 4-jointed, with two strong lancet-shaped spines at the apex of the last joint, together with one long and four or five very short setæ; at the base of the external margin are also a few small setæ; the second joint gives origin to a 1-jointed secondary branch, which terminates in a long plumose seta. Mandible simple, consisting of a short stout peduncle bearing a very long plumose seta." (Mr. Brady adds, "Probably also a filiform palp, though I have not seen this." I have not been able to detect any trace of a palp either, but have not had a sufficient number of specimens to examine.) "Maxillæ composed of two stout digits (or digit-formed processes), one of which bears three, the other four stout, curved, and densely plumose setæ." Basal joints of both pairs of foot-jaws stout, terminal claws elongated, curved—"Outer and inner branches of the swimming-feet nearly equal in length, 3-jointed, all the joints much constricted at the base, first and second joints dilated at the apex, third elongated and narrow; the distal margins of the first and second joints are strongly dentated, and in the inner branch are, at the outer angles, produced downwards into sharp spines; the marginal spines of the outer branch are long and dagger-shaped, the last joint of both branches bearing a long subulate and much attenuated apical spine. Fifth pair of feet stout, 2-jointed, first joint shorter than broad, and bearing one long seta, second longer than broad, and furnished with five long, subequal, terminal setæ. Caudal segments

about thrice as long as broad, and nearly equal in length to the last two abdominal somites; terminal setæ five, finely plumose, three short and two of moderate length, the longest being more than equal to the length of the abdomen. Length, $\frac{1}{26}$ of an inch."

Hab. One specimen obtained by the dredge in Otago Habour in 7 fathoms; its length was only $\frac{1}{48}$ of an inch, but in all respects except size it conforms exactly to the above description. This species occurs in the British seas, but has apparently only been recorded by Messrs. Brady and Robertson.

EXPLANATION OF PLATES V.–XI.

(The small figures indicate the number of times the figures have been magnified.)

PLATE V.

Figs. 1-8. *Amymome clausii.*
1. Adult animal; 2. anterior antenna; 3. mandible; 4. maxilla; 5. leg of the first pair; 6. leg of the third pair; 7. leg of the fourth pair; 8. integument.

Figs. 9-14. *Conostoma elliptica.*
9. Adult animal; 10. anterior antenna; 11. mouth-siphon; 12. anterior foot-jaw; 13. posterior foot-jaw; 14. leg of the first pair.

Figs. 15-19. *Thorellia brunnea*, var. *antarctica.*
15. Anterior antenna; 16. posterior antenna; 17. posterior foot-jaw; 18. foot of fifth pair; 19. caudal lamellæ and setæ.

PLATE VI.

Figs. 1-9. *Boeckia triarticulata.*
1. Adult female; 1. adult male; 2. anterior antenna (male), right side; 3. posterior antenna; 4. mandible and palp; 5. maxilla; 6. anterior foot-jaw; 7. posterior foot-jaw; 8. leg of fifth pair (female); 9. leg of fifth pair (male).

Figs. 10-11. *Porcellidium fulvum.*
10. Leg of first pair; 11. extremity of abdomen and fifth pair of feet (female).

Figs. 12-16. *Harpacticus chelifer.*
12. Anterior antenna (female); 13. anterior antenna (male); 14. posterior foot-jaw; 15. leg of first pair; 16. leg of second pair.

PLATE VII.

Figs. 1-7. *Scutellidium tisboides.*
1. Adult female; 2. anterior antenna (female); 3. anterior antenna (male); 4. posterior antenna; 5. foot of first pair; 6. foot of fifth pair (female); 7. posterior foot-jaw.

Figs. 8-13. *Porcellidium fulvum.*
8. Adult female; 9. adult male; 10. anterior antenna (female); 11. anterior antenna (male); 12. posterior antenna; 13. portion of integument.

PLATE VII.

Figs. 1-8. *Idya furcata.*
1. Anterior antenna (fem.), (*a*) rostrum; 2. posterior antenna; 3. mandible; 4. anterior foot-jaw; 5. posterior foot-jaw; 6. foot of first pair; 7. foot of fifth pair (fem.); 8. adult male.

Figs. 9-14. *Acontiophorus scutatus.*

9. Adult female, (*a*) mouth-siphon, (*b*) anterior foot-jaw, (*c*) posterior foot-jaw; 10. anterior antenna (fem.); 11. posterior antenna; 12. mandible; 13. anterior foot-jaw; 14. posterior foot-jaw.

Figs. 15-22. *Diarthrodes minuta.*

15. anterior antenna; 16. posterior antenna; 17. mandible; 18. anterior foot-jaw; 19. posterior foot-jaw; 20. foot of first pair; 21. foot of second pair; 22. foot of fifth pair.

Plate IX.

Figs. 1-7. *Artotrogus boeckii.*

1. Adult female; 2. anterior antenna; 3. posterior antenna; 4. mouth siphon; 5. mandible; 6. anterior foot-jaw; 7. posterior foot-jaw.

Figs. 8-10. *Cyclops gigas* (female).

8. anterior antenna; 9. foot of fifth pair; 10. extremity of abdomen and caudal setæ.

Figs. 11-19. *Cyclops chiltoni.*

11. Adult female; 12. anterior antenna of male; 13. posterior antenna; 14. labrum; 15. mandible; 16. anterior foot-jaw; 17. posterior foot-jaw; 18. foot of first pair; 19. foot of fifth pair.

Plate X.

Figs. 1-7. *Zaus contractus.*

1. Adult female (?); 2. anterior antenna; 3. posterior antenna; 4. posterior foot-jaw; 5. foot of first pair; 6. foot of third pair (external branch); 7. foot of fifth pair.

Figs. 8-15. *Xouthous novæ-zealandiæ.*

8. Adult male; 9. anterior antennæ, (*a*) male, (*b*) female; 10. posterior antennæ; 11. mandible; 12. posterior foot-jaw; 13. foot of first pair; 14. foot of third pair; 15. foot of 5th pair.

Figs. 16-21. *Thalestris forficula.*

16. Anterior antenna (male); 17. anterior antenna (female); 18. posterior antenna; 19. posterior foot-jaw; 20. foot of first pair; 21. foot of fifth pair (female).

Figs. 22-27. *Merope hamata.*

22. Adult female; 23. Anterior antenna; 24. posterior foot-jaw; 25. foot of first pair; 26. foot of fourth pair; 27. foot of fifth pair.

Plate XI.

Figs. 1-10. *Laophonte australasica.*

1. Anterior antenna; 2. posterior antenna; 3. mandible; 4. maxilla; 5. anterior foot-jaw; 6. posterior foot-jaw; 7. foot of first pair; 8. foot of fourth pair; 9. foot of fifth pair; 10. abdomen.

Figs. 11-14. *Artotrogus ovatus.*

1. Adult female; 12. posterior antenna; 13. mouth-siphon; 14. foot of fifth pair.

Fig. 15. *Porcellidium interruptum.*

Figs. 16-18. *Cyclops æquoreus.*

16. Anterior antenna (female); 17. foot of fifth pair; 18. abdominal segments.

Figs. 19-22. *Cyclops serrulatus.*

19. Anterior antenna (female); 20. posterior antenna; 21. foot of fifth pair; 22. caudal segments and setæ.

G.M.Thomson. del.

N.Z. COPEPODA.

ART. V.—*Notes on the Structure of* Struthiolaria papulosa.

By Professor F. W. HUTTON.

[*Read before the Philosophical Institute of Canterbury, 7th September,* 1882.]

Plate XII.

LAST year Mr. J. D. Enys kindly gave me two specimens, male and female, of *Struthiolaria papulosa* which he had collected at Nelson and preserved in spirit. All that is known at present of the structure of *Struthiolaria* is contained in the description of the animal of *S. crenulata* (= *S. australis*) in the Zoology of the Voyage of the Astrolabe (vol. ii., p. 430, pl. 31, fig. 7–9), in which a female is figured, and a description of the lingual dentition in the Trans. N.Z. Institute, vol. xiv., p. 163, pl. vi., fig. H. A few remarks on the specimens collected by Mr. Enys will, therefore, be interesting.

The œsophagus is long, expanding gradually into the stomach (fig. 3 *m.*) ; the intestine turns abruptly forward to the heart, passes through a loop of the anterior aorta, and proceeds at once to the anus, which freely projects from the mantle. The odontophore is very small and easily overlooked. The liver is large and greenish or greenish-brown, it lies on the lower side of the spiral portion of the animal, the upper side being occupied by the reproductive organs ; the hepatic duct opens at the pyloric end of the stomach, just where the intestine begins. The heart is large, and pale-yellow in colour. The gill is single attached to the mantle along the left side, the plates being very long, stiff, and free ; they appear to me to be simple, and not "boutonnées" as stated by Quoy. The renal organ lies at the base of the gill, and a duct, formed by a fold of skin, leads from it over the anterior portion of the body inside the rectum (fig. 1–3 *g*) ; in the male it opens at the base of the penis ; in the female, between the right tentacle and the anus. The male reproductive organs consist of a scarlet-lake testis and a long vas-deferens formed by a fold of skin running along the anterior part of the body, inside the renal duct, to the base of the right tentacle and ends in a long slender non-retractile curved penis (fig. 1–2 *d*). In the female the ovary is of a cream colour ; the oviduct is like the vas-deferens, but it ends behind the right tentacle in an expanded fold of skin.

In my paper of last year I figured the different teeth isolated from each other, I therefore append to this paper a sketch of the teeth in their natural position (fig. 4.) I have also added a figure of the operculum (fig. 5), as it is incorrectly given by H. and A. Adams in their Genera of Recent Mollusca, and also an outline of the animal of *S. australis* from the Voyage of the Astrolabe.

EXPLANATION OF PLATE XII.

Fig. 1. *Struthiolaria papulosa*. Male.

Fig. 2. " " " Branchial cavity laid open.

Fig. 3. " " Female. Branchial and abdominal cavities laid open.

All three drawings are taken from spirit specimens.

a, foot; *b*, operculum; *c*, rostrum; *d*, penis; *e*, vas-deferens; *f*, oviduct; *g*, renal duct; *h*, mantle; *i*, branchia; *k*, columellar muscle; *l*, siphon; *m*, stomach; *n*, anus; *o*, heart.

Fig. 4. *Struthiolaria papulosa*. Dentition magnified 160 times.

Fig. 5. " " Operculum magnified two diameters.

Fig. 6. " *australis*. Living animal, after Quoy. (Female.)

Art. VI.—*Notes on some* Branchiate Gastropoda.

By Professor F. W. Hutton.

[*Read before the Philosophical Institute of Canterbury, 3rd August*, 1882.]

Plates XIII.–XVI.

Aplysia tryoni, Meinertzhagen. Pl. XIII., fig. a.

Dentition, 13–1–13. Teeth quadrate, with basal and reflected portions. Reflexed portion of central tooth trilobed, with a single cutting-point on the median and two small ones on each of the lateral lobes. Interior laterals three-lobed, the interior one the largest, each with a smooth cutting-point. Outer laterals one-lobed, with a toothed cutting-point. The three outer marginals reduced to plates.

The teeth figured are from a dried specimen collected at Napier, and given me by Mr. Tryon.

Calliopæa felina, Hutton. Pl. XIII., fig. b.

Radula consists of about eleven blunt oval teeth placed in a single series, and getting gradually smaller.

The specimen figured came from Lyttelton.

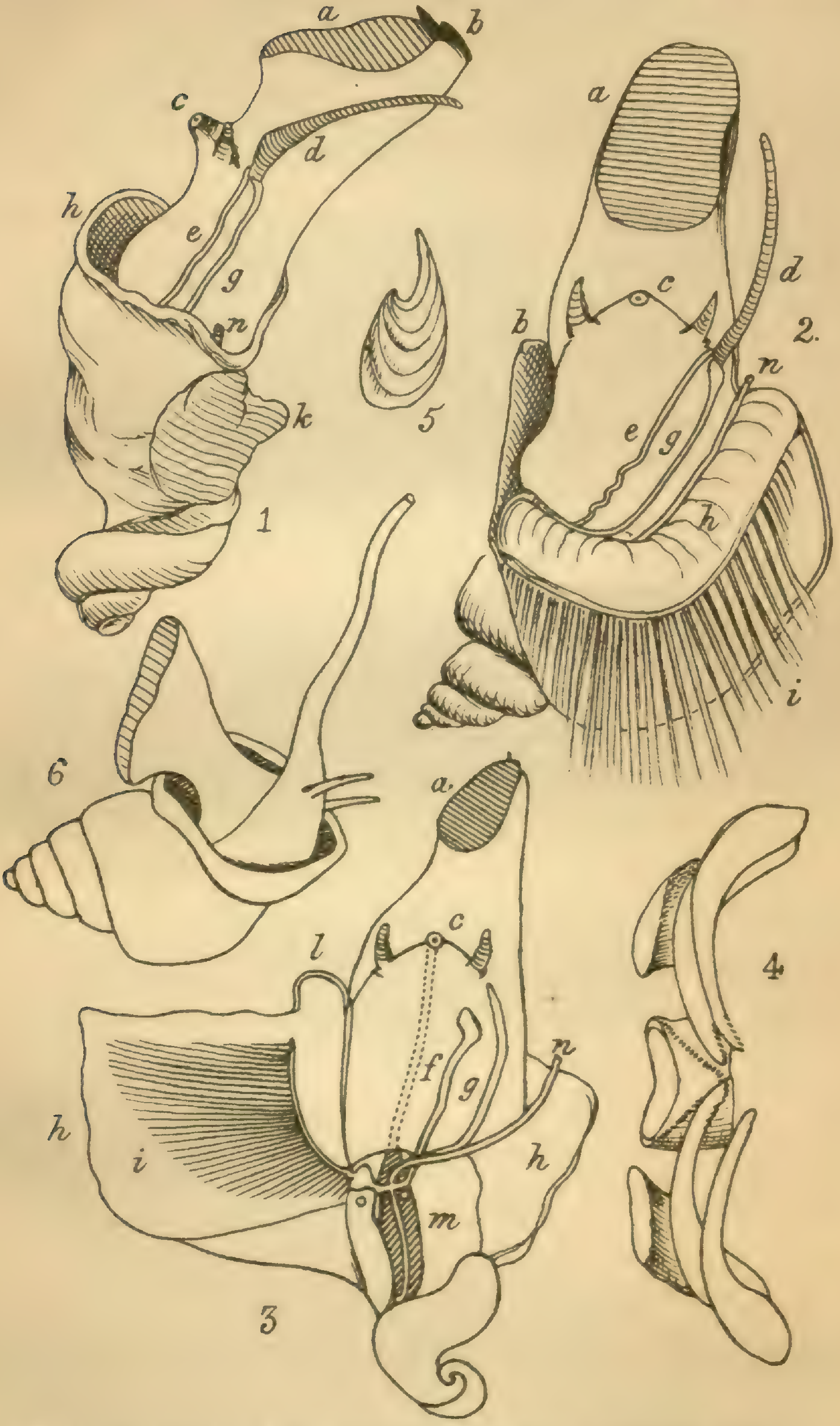
Murex octogonus, Quoy and Gaimard. Pl. XIII., fig. c.

Dentition.—Central tooth with five nearly equal and equidistant cusps, the anterior surface concave, and the sides rounded. *Operculum* ovate, the nucleus subapical.

I am indebted to Mr. T. F. Cheeseman for specimens from Auckland.

Trophon paivæ, Crosse. Pl. XIII., fig. d.

Animal white, speckled with dead white. Foot slightly expanded and rounded in front, obtusely pointed behind. Tentacles approximated, the eyes on their external sides about two-thirds up from the base; siphon short, barely protruding from the canal. *Dentition.*—Central tooth with five pointed cusps, the middle one the largest, and those on each side of it



To illustrate Professor Hutton's paper on
STRUTHIOLARIA PAPULOSA.

F.W.H. del.

smallest; the anterior surface straight, and the sides truncated. *Operculum* ovate, with the nucleus subapical; horny, transparent round the margin, the middle portion chestnut red, deeply trilobed on the inner edge.

The specimens figured were collected at Lyttelton.

TROPHON DUBIUS, Hutton. Pl. XIII., fig. E.

Animal of a bright salmon-red colour. *Dentition.*—Odontoglossate, the lateral teeth not being versatile. Central tooth small, rectangular, longer than broad, with three small acute rather distant cusps; lateral teeth broad, curved, with seven cusps; the inner small, the next five subequal and close together, the outer small and distant from the others. *Operculum* ovate, subconcentric.

The specimens figured were collected in Auckland. The dentition shows that this species belongs to the *Fusidæ*, while its smooth columella and fusiform shell put it into the *Fusinæ*: the operculum, however, is quite different from any other species of the family, and it must therefore be placed in a new genus, which I propose to call *Taron.*

NEPTUNÆA DILATATA, Quoy and Gaimard. Pl. XIII., fig. F.

Dentition.—Central tooth arched with four rather long cusps with rounded points of which the two inner are slightly the larger; posterior margin deeply concave. Lateral teeth with three curved cusps, the outer longer and distant from the other two. *Operculum* oblong, rather unguiculate, nucleus apical.

I am indebted to Mr. T. F. Cheeseman for specimens in spirit from Auckland.

Professor Troschel has given a figure of the dentition of this species (Das Gebiss der Schnecken, ii. taf. vi., fig. 17) which differs very much from mine, and I cannot account for the difference.

NEPTUNÆA NODOSA, Martyn. Pl. XIII., fig. G.

Dentition.—Central tooth quadrate, the breadth three times the length, with four subequal triangular cusps placed close together. Lateral teeth as in the last species, but the cusps more curved. *Operculum* like that of the last species.

The specimen figured was sent me from Auckland by Mr. T. F. Cheeseman.

EUTHRIA LINEATA, Chemnitz. Pl. XIII., fig. H.

Dentition.—Central tooth deeply curved, and the ends bent backward; a single tricuspidate cutting-point in the centre: laterals with three subequal and equidistant cusps. *Operculum* oval, the nucleus apical.

The specimen figured was collected at Lyttelton. The dentition of this species is quite different from that of its supposed variety C, figured in the Trans. N.Z. Inst., xiv., pl. vi., fig. D. This latter must therefore be

considered as a distinct species; it may, however, be the same as *E. littorinoides*, Reeve. I have collected at Lyttelton a single living specimen of *E. striata*, Hutton (Trans. N.Z. Inst., vii., p. 458), and find that its dentition exactly resembles that of *E. lineata* here figured, the shell is quite colourless, but the animal is spotted with maroon brown.

EUTHRIA VITTATA, Quoy and Gaimard. Pl. XIII., fig. I.

Dentition.—Central tooth nearly as long as broad, flat in front, convex behind, with three acute denticles; lateral teeth with the outer cusp very large, the two inner small and close together. *Operculum* oval, sub-unguiculate, nucleus apical.

The specimens figured were collected at Auckland.

COMINELLA VIRGATA, Adams. Pl. XIII., fig. K.

Dentition and *operculum* normal.

The specimen figured was collected at Auckland.

COMINELLA MACULATA, Martyn. Pl. XIII., fig. L.

Dentition and *operculum* normal.

The specimen figured was collected at Auckland.

COMINELLA MACULOSA, Martyn. Pl. XIII., fig. M.

Dentition and *operculum* normal. *Animal.*—Foot emarginate in front; yellowish white, reticulated with bluish black, and margined anteriorly with yellowish white. Siphon moderate, tapering, black (drawn too long by Quoy, Voy. Astrol., pl. 30, f. 8–10). Eyes half-way up the tentacles. Tentacles black above the eyes, and slightly tipped with white; below the eyes they are longitudinally streaked with black.

The specimens described were collected at Lyttelton.

COMINELLA TESTUDINEA, Chemnitz. Pl. XIII., fig. N.

Dentition and *operculum* normal.

The specimen figured was collected at Auckland.

POLYTROPA HAUSTRUM, Martyn. Pl. XIII., fig. O.

Animal.—White; tentacles short and blunt, the eyes situated more than half-way up. *Dentition.*—Central tooth broad, slightly curved with five subequal triangular contiguous cusps. *Operculum* oval, the nucleus sub-lateral.

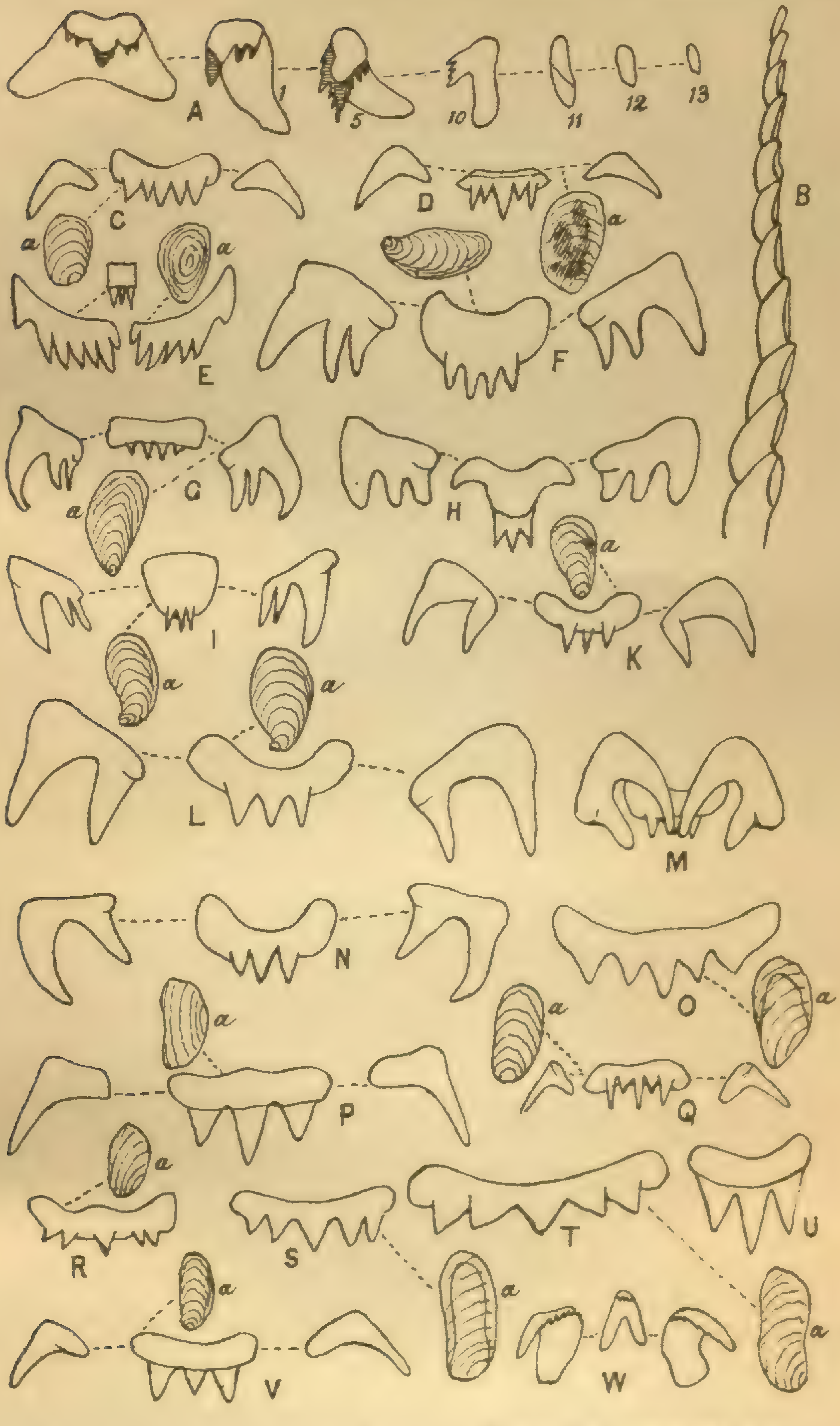
The specimen figured was collected in Auckland.

This species has usually been put into *Purpura*, but its operculum is sufficient to remove it from that genus, and the aperture has no posterior canal.

PURPURA TEXTILIOSA, Lamarck. Pl. XIII., fig. P.

Dentition.—Central tooth slightly sinuous, with three long triangular cusps, the median of which is the largest. *Operculum* semi-cordate, the nucleus lateral, on the exterior side.

The specimen figured was collected in Auckland.



To illustrate Professor Huttons paper on
BRANCHIATE GASTEROPODA.

F.W.H. del.

The operculum and the posterior canal show that this species belongs to *Purpura*, and not to *Polytropa* where it is usually placed.

POLYTROPA QUOYI, Reeve. Pl. XIII., fig. Q.

Dentition.—Central tooth convex in front and straight behind, with five narrow pointed, separated, denticles the external and median subequal, the intermediate two much smaller. *Operculum* ovate, the nucleus sub-apical.

The specimen figured was sent me from Auckland by Mr. T. F. Cheeseman.

The columella in this species is rounded and the operculum is muricoid. It is evidently not a *Polytropa* but a *Trophon.*

POLYTROPA STRIATA, Martyn. Pl. XIII., fig. R.

Dentition.—Central tooth arched with a convex sinuation in the middle of the anterior margin. Cusps five, the median one isolated from the others and sometimes much longer. *Operculum* ovate, the nucleus sub-lateral.

The specimen figured was collected at Lyttelton.

POLYTROPA SCOBINA, Quoy and Gaimard. Pl. XIII., fig. S.

Dentition resembles that of *P. haustrum. Operculum* oblong, the nucleus sub-lateral.

The specimen figured was collected at Auckland.

POLYTROPA ALBOMARGINATA, Deshayes. Pl. XIII., fig. T.

Dentition resembles that of *P. haustrum*, but the cusps are broader. *Operculum* oval, the nucleus sub-lateral.

The specimen figured was collected at Lyttelton.

The species is the same as *P. tristis*, Dunker.

VOLUTA PACIFICA, Lamarck. Pl. XIII., fig. U.

Dentition.—Teeth arched, with three large subequal triangular cusps occupying the whole of the posterior margin. *Operculum* none.

The specimen figured was sent from Auckland by Mr. T. F. Cheeseman.

ANCILLARIA AUSTRALIS, Sowerby. Pl. XIII., fig. V.

Dentition.—Central tooth slightly arched and square at the ends with three rather distant cusps, the middle one of which is the smallest. There are no denticles: lateral teeth like *Purpura. Operculum* oval, the nucleus sub-apical.

The specimen figured was sent from Auckland by Mr. T. F. Cheeseman.

CORIOCELLA OPHIONE, Gray, (*Lamellaria* ?). Pl. XIII., fig. W.

Shell as described by Gray. Length ·25, breadth ·15 inch, resembles that of *Cryptocella latens*, Adams (Gen. Moll., pl. 21, f 4, *b*), and covers the whole animal. *Animal* with the mantle smooth covering the whole shell, not fissured on the back, notched in front; yellowish, marbled with grey; foot small, square in front, tapering behind, entirely covered by the mantle. Top of the head dark grey, or purple; eyes at the outer bases of the tentacles, which are large, and separated. *Dentition*, 1–1–1; central

tooth with the base produced into two long processes, the anterior end slightly reflected and trilobed; lateral teeth versatile, broad, situated at some distance from the central tooth, their apices acute, uncinate, and denticulated on the inner side.

Several specimens of this little mollusc were sent me by Mr. T. F. Cheeseman from Auckland, where, I believe, it is not uncommon. The animal much resembles the *Coriocella noire*, Blainville, Malacol., t. 42, f. 1*a*, figured by Gray in Figures of Molluscous Animals, pl. 104, f. 3. I take it to be Gray's *Lamellaria ophione*, because it is said to be not uncommon at Auckland, but Gray's description would do for many species of different genera, and by itself is unrecognizable.

The animal mentioned by me in the Manual of New Zealand Mollusca, p. 59, as perhaps *Lamellaria ophione* is quite different, and may be called *Lamellaria cerebroides*.

Crypta costata, Deshayes. Pl. XIV., fig. a.

Dentition.—Central tooth nearly as broad as long, the reflected portion with three denticles on each side and a long median cutting-point; the first lateral has seven denticles, the second and third are nearly smoth, with four or five obsolete denticles on the outer side. There is a papillate horny jaw on each side of the mouth.

The specimen figured was sent from Auckland by Mr. T. F. Cheeseman.

Crypta monoxyla, Lesson. Pl. XIV., fig. b.

Dentition.—Central tooth considerably longer than broad, with a single lobe or denticle on each side of the reflected portion. First lateral with the reflected portion sharply denticulated on both sides, about two denticles inside and five outside the large apical denticle; second and third lateral strongly denticulated on the outer side.

The specimen figured was collected at Auckland.

Turritella rosea, Quoy and Gaimard. Pl. XIV., fig. c.

Dentition.—Length of central tooth rather more than half the breadth, the reflected portion finely denticulated on each side, and with a larger median cutting-point. First lateral finely denticulated on the outer side; second lateral much broader than the third and spoon-shaped at the tip; both are finely denticulated on the outer side.

The specimen figured was sent from Auckland by Mr. T. F. Cheeseman.

Cerithidea bicarinata, Gray. Pl. XIV., fig. d.

Dentition.—Length of the central tooth about two-thirds of the breadth; the posterior corners with a sharp cusp, which carries a single denticle at its inner base; reflected portion trilobed, the middle lobe larger and with a cutting-point. First lateral broad, produced at the outer basal end into a short stalk, reflected portion with a broad denticle and four or five smaller

ones outside it; second lateral unguiculate, with four denticles; third lateral broader than the second, and with five denticles. *Operculum* multispiral, with a ragged edge.

The specimen figured was collected at Auckland.

Cerithidea nigra, Hombron and Jacquenot. Pl. XIV., fig. e.

Animal black, sparingly spotted with yellowish; head-lobes marked with yellowish; tentacles black, with three or four rings of white. *Dentition.*—Length of central tooth rather more than half the breadth, reflected portion with five cusps, otherwise like *C. bicarinata.* First lateral like *bicarinata*, but the broad denticle often bifid; second and third laterals like *bicarinata*, but the third with six denticles.

The specimen figured was collected at Auckland.

Melanopsis trifasciata, Gray. Pl. XIV., fig. f.

Dentition.—Central tooth subquadrate, broader than long, the posterior angles sharp, the posterior margin wtth a convex, and the anterior margin with a concave sinuation; reflected portion with three denticles on each side and a broad and pointed cutting-point, that extends under the denticles. First lateral broad with three or four denticles. Second lateral rather broad with a spoon-shaped tip provided with three blunt denticles, a clavate accessory piece attached to the outer posterior corner. Third lateral narrow expanded into a denticulate spoon-shaped apex. *Operculum* oval with the nucleus subapical.

The specimen figured was sent by Mr. T. F. Cheeseman.

Janthina exigua, Lamarck. Pl. XIV., fig. g.

Dentition.—Similar to that of *J. communis.*

The specimen figured was given me by the Hon. G. McLean.

Nerita atrata, Lamarck. Pl. XIV., fig. h.

Dentition.—Central tooth rather small, quadrate, longer than broad, posterior margin concave with a cutting-point in the centre. First lateral very broad, the breadth nearly three times the length, expanding outwards, and with a cutting-point on the inner posterior angle. Second and third laterals minute plates; fourth lateral with a breadth twice the length, arched, with a broad dark brown opaque cutting-point. Marginals numerous with smooth points.

The specimen figured was collected at Auckland.

There are only four laterals, and the dentition seems to connect the *Trochidæ* with the *Chitonidæ*, although decidedly rhipidoglossal.

Huttonia bella, Hutton (*Euchelus*). Pl. XIV., fig. i.

Dentition.—Central tooth trilobed at the base, the central lobe smaller and not projecting beyond the lateral lobes, reflected portion denticulated on the sides. Laterals five, similar, getting longer as they are further away

from the central tooth, denticulated on each side. Marginals denticulated on the outer side, those near the margin very narrow and sigmoid. *Operculum* horny, of few (3 or 4) whorls; pale in colour and transparent, the nucleus central.

The specimen figured was sent from Auckland by Mr. T. F. Cheeseman.

Mr. T. W. Kirk, in the Trans. N.Z. Inst., xiv., p. 282, has proposed a new genus, *Huttonia*, to include this and two other species which he there describes, and the operculum proves to be very different from that of *Euchelus*.

Anthora tuberculata, Gray. Pl. XIV., fig. k.

Animal yellowish-brown, foot reddish-brown or purplish-brown; side lappets and head-lobes margined with white: proboscis reddish- or purplish-brown, margined with white: filaments white, three on a side. The head lobes are smooth and rounded and joined together over the head. The eyes are on rather long white peduncles. *Dentition* similar to that of *A. tiaratus*, but the central tooth not so broad. *Operculum* horny, multispiral.

The specimen figured was collected at Lyttelton.

Zizyphinus selectus, Chemnitz. Pl. XIV., fig. l.

Dentition like that of *Z. punctulatus*, but the first marginal appears to be short and broad; possibly this may be a broken specimen.

The specimen figured was collected at Auckland.

Gibbula oppressa, Hutton. Pl. XIV., fig. m.

Dentition.—Central tooth with the posterior margin straight. Fifth lateral with several short cutting-points. All the cutting-points smooth. *Operculum* horny, multispiral, with radiating striæ.

The specimen figured was sent by Mr. T. F. Cheeseman from Auckland.

Margarita (?) inconspicua, Hutton. Pl. XIV., fig. n.

Dentition similar to *Cantharidus*. Central tooth with a slight median lobe on the posterior margin; the first four laterals similar, the cutting-point denticulated on the inner side; fifth lateral with a large cutting-point on the inner side and two small ones outside it.

The specimen figured was sent from Auckland by Mr. T. F. Cheeseman.

Cantharidus purpuratus, Martyn. Pl. XIV., fig. o.

Animal pale yellowish; foot pointed behind, speckled with brown and transversely banded in front with reddish-brown or brown, and bordered with pale yellowish; rostrum greenish-yellow; head-lobes smooth; tentacles yellow or pale purplish; eye-peduncles yellowish-white, short and slender; filaments three on a side. *Dentition* normal, the central tooth rather broader than high.

The specimen figured was collected at Lyttelton.

To illustrate Professor Huttons paper on
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F.W.H. del.

CALCAR COOKII, Chemnitz. Pl. XIV., fig. P.

Dentition.—Central tooth elongated, anterior half with parallel sides, posterior half expanded; winged on each side near the middle, posterior margin straight; no cutting-point. First to fourth lateral similar, broad, without cutting-points, with two wings on the exterior side which receive between them the inner side of the next tooth. Fifth lateral with the outer posterior corner produced into a long stalk, the reflexed portion tricuspid. First marginal very large, produced anteriorly and reflected at the margin, a strong triangular cutting-point arising from the middle of the tooth. Marginal teeth with smooth cutting-points.

The specimen figured was sent from Auckland by Mr. T. F. Cheeseman. The dentition is so very different from that of *Calcar imperialis* (as figured by Hogg) that the two cannot be placed in the same genus, and the name *Calcar cookii* will have to be altered to *Cookia sulcata*, Martyn.

DILOMA ÆTHIOPS, Gmelin. Pl. XV., fig. A.

Dentition.—Central tooth broader than long, oblique, sloping posteriorly to the left, reflexed portion without cutting-points, but serrated on both sides at the base. Lateral teeth with cutting-points which are denticulated on both sides, those on the outer side being stronger. Outer marginals denticulated on both sides, the inner marginals denticulated on the outer side only.

The specimen figured was collected at Lyttelton.

DILOMA NIGERRIMA, Chemnitz. Pl. XV., fig. B.

Animal black: head with a narrow transverse band of yellow near the front margin; rostrum margined with white: tentacles long and tapering, longitudinally striped with black and yellowish. Filaments blue-black, three on a side, sometimes a fourth on the left side.* Foot white, closely and finely marbled with blue-black, and broadly margined with yellow veined with black. *Dentition.*—Central tooth much broader than long, oblique, sloping posteriorly to the right, the reflexed portion serrated on both margins, cutting-points of lateral teeth denticulated on both sides, but more strongly on the outside. Cutting-points of marginal teeth strongly denticulated on both sides.

The specimen figured was collected at Lyttelton. The movements of this species are very rapid, quite different from those of the other species of the genus.

DILOMA UNDULOSA, Adams. Pl. XV., fig. C.

Animal brownish-black; rostrum narrowly margined with yellow; tentacles margined with white; eye-peduncles broad and short; head-lobes pectinated; the right side lappet smooth, the left pectinated between the

* I have noticed the same in *D. æthiops*.

filaments and the eye peduncles: filaments three on each side. *Dentition.* —Central tooth rather broader than long, not oblique, reflexed portion serrated on both sides at the base. Cutting-points of laterals and inner marginals denticulate on outer edge only, those of the outer marginals denticulated on both sides.

The specimen figured was collected at Sumner.

Diloma corrosa, Adams (= *D. hectori*, Hutton). Pl. XV., fig. d.

Animal the same as *D. undulosa.* *Dentition.*—Central tooth much broader than long, oblique, sloping posteriorly to the right. Cutting-points of laterals and inner marginals denticulated on the outer edge only, those of the outer marginals on both sides.

The specimen figured was collected at Sumner. It is, I think, only a variety of the last species.

Diloma plumbea, sp. nov. Pl. XV., fig. e.

Shell turbinate, imperforate, rather depressed, rough, sometimes with a few obsolete spiral ribs; whorls four or five; spire acute but usually eroded; colour bluish-purple, the eroded apex whitish. Interior white, iridescent, the throat with shallow grooves, aperture margined with a black band; columella impressed, curved, sometimes with a small anterior tooth. Axis ·5; breadth ·63. *Animal* like *D. æthiops*, the foot being margined with a band of black and white transverse stripes. *Dentition.*—Central tooth as in *D. corrosa.* Cutting-points of lateral teeth denticulated on both sides. Cutting-points of inner marginals denticulated on outer edge only, those of the outer marginals on both edges.

The specimen figured was collected at Sumner. The shell is not easy to distingush from some varieties of *D. undulosa* which has the same station, and the central tooth is like that of *D. corrosa*, but the animal and the lateral and marginal teeth are like *D. æthiops.* It is found usually in sheltered bays or estuaries, but sometimes on exposed rocks. I have collected it at Sumner and the Ocean Beach, Dunedin, and I have also seen specimens from Campbell Island.

Diloma excavata, Adams. Pl. XV., fig. f.

Dentition.—Central tooth broader than long, not oblique, the reflexed portion denticulated all along the edge; the cutting-points of the laterals and all the marginals are denticulated on both edges.

The specimen figured was collected by Mr. T. F. Cheeseman at North Manukau Heads.

Diloma (?) subrostrata, Gray. Pl. XV., fig. g.

Dentition.—Central tooth broader than long, not oblique, the reflected portion strongly denticulated on each side and eared. Cutting-points of lateral teeth slightly denticulated on each side; those of the inner marginals

denticulated on the outer side only, those of the outer marginals strongly denticulated on both sides.

The specimen figured was collected at Auckland, on *Zostera*. The eared central tooth differs from all the other species of *Diloma*.

HALIOTIS IRIS, Martyn. Pl. XV., fig. H.

Animal sooty-black; foot deeply notched in front. *Dentition*, ∞-5-1-5-∞. Central tooth about as broad as long, rounded posteriorly, and eared, reflexed portion without cutting-points, a long process projecting backward and upward on each side below the reflexed portion. First lateral broader than long, subquadrate, without cutting-points. Second lateral oval, longer than broad, without cutting-points. Third lateral long and narrow with a clavate process extending from the exterior side, and the whole of the interior side occupied by a large cutting-point. Fourth lateral like the third but shorter and broader. Fifth lateral oblong, transverse, with a blunt cutting-point on the inner side. Marginals slender, denticulate on both edges.

The specimen figured was collected at Lyttelton.

PARMOPHORUS UNGUIS, Linné. Pl. XV., fig. I.

Dentition.—Central tooth subquadrate, broader than long, the reflexed portion without cutting-points. First to fourth laterals similar, oval, the length three times the breadth, without any cutting-points. Fourth and fifth laterals large with two strong cutting-points.

The specimen figured was collected at Lyttelton.

ACMÆA CONOIDEA, Quoy and Gaimard. Pl. XV., fig. K.

Animal.—Margin of the mantle not fringed. *Dentition*.—Length of the teeth more than three times the breadth, the recurved portions moderate; basal plates subrectangular, much longer than broad. No accessory teeth.

The specimen figured was collected at Sumner.

ACMÆA CORTICATA, Hutton. Pl. XV., fig. L.

Animal.—Margin of the mantle not fringed. *Dentition*.—Teeth rather broad, the recurved portions very broad and blunt; basal plates imbricating, the anterior margin straight, the posterior and exterior margins deeply sinuated, the interior margin concave; a pair of accessory hooked teeth on each side.

The specimen figured was collected at Dunedin.

ACMÆA PILEOPSIS, Quoy and Gaimard. Pl. XV., fig. M.

Dentition.—Length of teeth more than half the breadth, the recurved portions rather long and pointed; basal plates rhomboidal, with a central longitudinal groove. No accessory teeth.

The specimen figured was collected at the Auckland Islands by Mr. E. Jennings, and sent me by Prof. T. J. Parker.

Acmæa flammea, Quoy and Gaimard. Pl. XV., fig. n.

Animal with the margin of the mantle fringed. *Dentition.*—Teeth much like those of *A. pileopsis*, but they are weak in the middle and often break when detached, so as to divide the anterior from the posterior recurved portion, thus approaching *Patella*, where the anterior and posterior portions are always separated. Basal plates subrectangular, the length about twice the breadth, and divided by a longitudinal line into two portions. No accessory teeth.

The specimen figured was collected at Lyttelton.

Patella magellanica, Martyn (?). Pl. XVI., fig. a.

Animal.—In this species, and in all the other of our *Patellidæ* that I have examined, the gills do not extend beyond the head, and the mouth is entire below, thus putting them into the genus *Nacella*, but the shell in all is thick and all live on rocks. In all the mantle is fringed. *Dentition.*—Inner teeth simple, pointed; outer bidentate on the outer side: central plate cuneate, divided down the centre; marginal plates rhomboidal, large.

The specimen figured was collected at the Auckland Islands by Mr. E. Jennings, and sent me by Prof. T. J. Parker.

Patella denticulata, Martyn (= *P. luctuosa*, Gould, Pl. XVI., fig. b).

Dentition.—Inner teeth simple, pointed, set near together; outer teeth with two denticles on the outer side, the lower often semi-detached; central plate lenticular, divided down the middle; marginal plates distant with a hooked anterior and jagged posterior end, a small detached plate a little above the hooked termination of the larger plate.

The specimen figured was collected at Dunedin.

Patella illuminata, Gould. Pl. XVI., fig. c.

Dentition.—Inner teeth with a single denticulation on the outer side; outer teeth with two denticulations on the inner and two on the outer side, the lower outer denticle detached; central plate lenticular; marginal plates linear forming a double series on each side.

The specimen figured was collected at Macquarie Island by Professor Scott, and sent me by Prof. T. J. Parker.

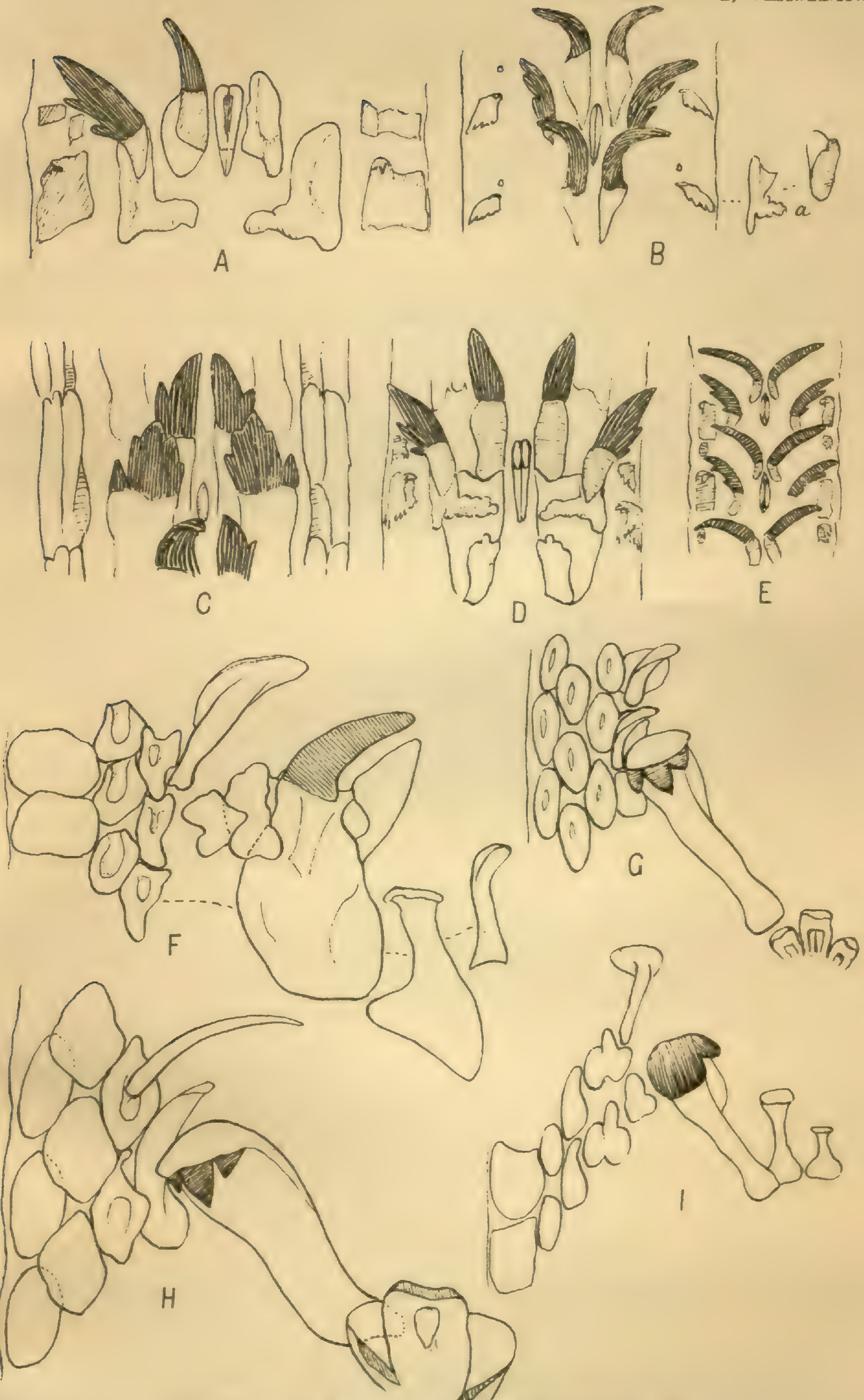
Patella olivacea, Hutton. Pl. XVI., fig. d.

Dentition.—Inner teeth simple, pointed; outer with two denticulations on the outer edge, the lower almost detached; central plate linear, or slightly cuneate, divided longitudinally into two, each half with a bright oval spot at the anterior end; marginal plates similar to those of *P. denticulata*, but the intermediate plate is much larger, and occupies most of the space between the hooked plates.

The specimen figured was collected at Dunedin; in the figure the inner teeth are shown too widely separated.

To illustrate Professor Huttons paper on
BRANCHIATE GASTEROPODA

F.W.H. del.



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BRANCHIATE GASTEROPODA

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PATELLA ARGYROPSIS, Lesson (= *P. radians*, Gml). Plate XVI., fig. E.

Dentition.—Inner teeth simple, pointed; outer with two denticulations on the outer side, the lower sometimes semi-detached, more often rectangular; central plate lenticular, divided longitudinally; marginal plates like those of *P. olivacea*, but the posterior margins smooth, and the intermediate plate sometimes hooked.

The specimen figured was collected at Lyttelton. *P. pholidota*, Lesson, has the same dentition, and can only be considered as a variety.

CHITON PELLIS-SERPENTIS, Quoy and Gaimard. Pl. XVI., fig. I.

Dentition.—7–1–7. Central tooth with a narrow neck and expanded base like some of the *Trochidæ*, the reflexed portion without cutting-points. First lateral like the central, but longer. Second lateral placed obliquely with a long stalk and an opaque blunt cutting-point like *Nerita.* First marginal trilobed: second with a projecting anterior process from the inner angle of which proceeds a peltate tooth on a long stalk: third and fourth marginals oval; the fifth subquadrate.

The specimen figured was collected at Lyttelton.

CHITON GLAUCUS, Gray. Pl. XVI., fig. F.

Dentition.—7–1–7. Central tooth spoon-shaped; first lateral like *Trochidæ*, with an unarmed reflexed portion: second lateral ovate with a large claw-shaped cutting-point on the anterior end, and an accessory plate below it: first and second marginals irregular: the third subtriangular, with a large ladle-shaped tooth arising from the inner side: fourth suboval; fifth subquadrate.

The specimen figured was collected at Dunedin.

ACANTHOCHITES ZEALANDICUS, Quoy and Gaimard. Pl. XVI., fig. G.

Dentition.—6–1–6. Central tooth quadrate, the reflexed portion without cutting-points: first lateral like the central but smaller: second lateral oblique, with a long stem and a recurved portion bearing three opaque dark-brown cutting-points: first marginal sub-quadrate; second, third, and fourth oval; from between the first marginal plates springs a spoon-shaped tooth.

The specimen figured was collected at Dunedin.

CRYPTOCONCHUS POROSUS, Burrow. Pl. XVI., fig. H.

Dentition.—6–1–6. Central tooth subquadrate, longer than broad, with a simple reflexed portion: first lateral curved round the central, the front portion reflexed: second lateral oblique, the stalk broad and rather sigmoid, the reflexed portion bearing three dark-brown opaque cutting-points: marginals ovate: from the first marginal there arises a spoon-shaped process, and from the second a large falcate process.

The specimen figured was collected at Lyttelton.

EXPLANATION OF PLATES XIII.—XVI.

Plate XIII.

A. *Aplysia tryoni.* Teeth.
B. *Calliopæa felina.* Radula.
C. *Murex octogonus.* Teeth. *a*, operculum.
D. *Trophon pairæ.* Teeth. *a*, operculum.
E. *Taron dubius.* Teeth. *a*, operculum.
F. *Neptunæa dilatata.* Teeth. *a*, operculum.
G. *Neptunæa nodosa.* Teeth. *a*, operculum.
H. *Euthria lineata.* Teeth.
I. *Euthria vittata.* Teeth. *a*, operculum.
K. *Cominella virgata.* Teeth. *a*, operculum.
L. *Cominella maculata.* Teeth. *a*, operculum.
M. *Cominella maculosa.* Teeth.
N. *Cominella testudinea.* Teeth.
O. *Polytropa haustrum.* Teeth. *a*, operculum.
P. *Purpura textiliosa.* Teeth. *a*, operculum.
Q. *Trophon quoyi.* Teeth. *a*, operculum.
R. *Polytropa striata.* Teeth. *a*, operculum.
S. *Polytropa scobina.* Teeth. *a*, operculum.
T. *Polytropa albomarginata.* Teeth. *a*, operculum.
U. *Voluta pacifica.* Teeth.
V. *Ancillaria australis.* Teeth. *a*, operculum.
W. *Coriocella ophione.* Teeth.

Plate XIV.

A. *Crypta costata.* Teeth.
B. *Crypta monoxyla.* Teeth.
C. *Turritella rosea.* Teeth.
D. *Cerithidea bicarinata.* Teeth and operculum.
E. *Cerithidea nigra.* Teeth.
F. *Melanopsis trifasciata.* Teeth and operculum.
G. *Janthina exigua.* A tooth.
H. *Nerita atrata.* Teeth. *a*, a marginal tooth.
I. *Euchelus bellus.* Teeth and operculum. *a*, an outside marginal tooth.
K. *Anthora tuberculata.* Teeth and operculum.
L. *Zizyphinus selectus.* First marginal tooth.
M. *Gibbula oppressa.* Teeth.
N. *Margarita inconspicua.* Teeth.
O. *Cantharidus purpuratus.* Central tooth.
P. *Calcar cookii.* Teeth.

Plate XV.

A. *Diloma æthiops.* Teeth.
B. *Diloma nigerrima.* Teeth. *a*, a marginal tooth.
C. *Diloma undulosa.* Teeth.
D. *Diloma corrosa.* Teeth.
E. *Diloma plumbea.* Teeth.
F. *Diloma excavata.* Teeth.
G. *Diloma subrostrata.* Teeth.

H. *Haliotis iris.* Teeth. *a*, a marginal tooth.
I. *Parmophorus unguis.* Teeth.
K. *Acmæa conoidea.* Teeth. *a*, plates; *b*, side view of tooth.
L. *Acmæa corticata.* Teeth. *a*, plates.
M. *Acmæa pileopsis.* Teeth. *a*, plates; *b*, side view of tooth.
N. *Acmæa flammea.* Teeth. *a*, plates.

Plate XVI.

A. *Patella magellanica.* Teeth (removed on one side).
B. *Patella denticulata.* Teeth. *a*, plates.
C. *Patella illuminata.* Teeth.
D. *Patella olivacea.* Teeth.
E. *Patella argyropsis.* Teeth.
F. *Chiton glaucus.* Teeth.
G. *Acanthochites zealandicus.* Teeth.
H. *Cryptoconchus porosus.* Teeth.
I. *Chiton pellis-serpentis.* Teeth.

Art. VII.—*Additions to the Molluscan Fauna of New Zealand.*

By Professor F. W. Hutton.

[*Read before the Philosophical Institute of Canterbury, 2nd March*, 1882.]

Polytropa cheesemani, sp. nov.

Shell small, fusiform, white, spirally ribbed, and between the ribs finely transversely lirated. Whorls five, those of the spire small, with a single smooth spiral rib; body-whorl large, with five spiral grooves between the ribs; ribs broad and smooth, grooves narrow and transversely lirated. Aperture moderate, contracted in front into a short, open, slightly-twisted canal; four or five short well-developed teeth inside the outer lip. Interior bright purple, without any white margin; columella slightly tinted with the same colour.

Length ·6; diameter ·35 inch.

Collected by Mr. T. F. Cheeseman at Port Waikato.

I have seen a considerable number of specimens, and they exhibit very little variation. The species is easily distinguished from *P. striata* by the small number of grooves on the body-whorl; and from *P. squamata* by the smooth ribs, and the colour of the interior. From *P. propinqua*, Tenison-Woods, it differs in having the grooves narrower, and one less of them, and in the outer lip not being smooth.

Pleurotoma (Drillia) awamoaensis, Hutton. Cat. Tertiary Mollusca of New Zealand (1874), p. 4.

Not uncommon at Waiwera, near Auckland (Cheeseman).

Shell small, thin, fusiform, turretted, white: whorls 8½, the first three or three-and-a-half smooth and convex, afterwards slightly carinated, spirally

lirated and transversely ribbed. Hinder parts of the whorls not concave; twenty transverse ribs on the penultimate whorl, and about the same number on the body-whorl, but difficult to count because partly obsolete, especially anteriorly; spiral liræ about seven on the spire whorls, subequal, body-whorl with fifteen or sixteen. Canal moderate; aperture elongately oval, posterior sinus very slight.

Length ·53; diameter ·2; length of aperture ·17 inch.

This species is distinguished from *P. buchanani* by the whorls being less carinated, not concave posteriorly, and the suture not margined; the recent specimens are not much more than half the size of the fossils from Awamoa.

Adeorbis (?) petterdi, Brazier (*Fossarina*). Jour de Conch., 1864.

I have received a specimen from Mr. T. F. Cheeseman, who informs me that he found four individuals at Waiwera, and that Mr. C. Mathews had also collected it at Omaha and Matakana. It is common in Tasmania.

Shell depressed, of three or four rapidly-increasing whorls, rimate, smooth, very faintly spirally striated; white, with zig-zag brown markings; aperture broader than long; yellowish, and not pearly inside. Operculum multispiral. Dentition rhipidoglossal.

I have examined an animal sent me from Tasmania by Mr. Petterd, and find that it belongs to the *Trochinæ*.

Acmæa flammea, Quoy and Gaimard. Voy. Astrolabe, Zool. iii., p. 354, pl. 71, f. 15–24 (*Patelloida*). Tenison-Woods, Pro. Roy. Soc. Tasmania, 1876, p. 51.

Shell small, oval, depressedly conical, finely radiately striated; apex about one-fourth the length of the shell from the anterior end, pointed and hooked: shell thin, semitransparent, pale yellowish-brown, ornamented with irregular, usually more or less radiating, lines of brown; interior silvery.

Length ·25 to ·3; breadth ·2 to ·23; height ·08 to ·1 inch.

Animal white, the margin of the mantle fringed.

This species is common on rocks and on other shells throughout New Zealand. It is also found in Tasmania, Australia, and the Island of Guam. Mr. Tenison-Woods describes the shell as "somewhat solid," but with us it is always very delicate and thin.

Acmæa conoidea, Quoy and Gaimard. Voy. Astrolabe, Zool. iii., p. 355, pl. 71, f. 5–7 (*Patelloida*).

Shell small, broadly oval, high, conical, smooth; apex rather anterior, blunt, usually rounded. Colour usually brown, but sometimes nearly white with brown radiating streaks; interior above the muscular impression dark or pale brown or blotched, margin dark brown, sometimes rayed with pale brown.

Length ·2 to ·25 ; breadth ·15 to ·17 ; height ·1 to ·2 inch.

Not uncommon with *Littorina* on the rocks at Sumner. Common in Tasmania. The specimens described by Quoy and Gaimard came from King George's Sound in Australia, where it is said to be very rare ; these specimens are much larger than ours, but I cannot make out any other difference. The margin of the mantle is not fringed.

Patella olivacea, sp. nov.

Shell ovate, narrowed in front, very finely radiately ribbed, about 70, often with included striæ ; ribs crossed by faint and irregular lines of growth ; apex between one-third and one-fourth of the length from the anterior end, usually eroded. Colour uniform olive brown ; interior bright silvery greyish with a narrow black line round the finely crenulated margin.

Length 1·3 ; breadth 1·0 ; height ·55 inch.

This species is distinguished from *P. argyropsis* by its numerous, nearly uniform ribs, and from *P. pholidota* by the apex being more central ; from both of them and from *P. earlii* it is also distinguished by its uniform colouring, and the black line round the margin. I have collected it at the Bluff, and at Dunedin.

Calliopæa felina, sp. nov.

Small head, upper surface of oral tentacles and branchiæ, black ; lower surface and tips of oral tentacles, and a spot behind each, yellowish-white ; a prominent eye in this white spot. No tentacles. Back sooty brown, lighter than the branchiæ. Branchiæ very large, unequal, two rows on each side, about seven in a row. Foot square in front, but not produced ; tail pointed. Length, ·4 inch.

Lyttelton harbour.

Calliopæa felina, Hutton.

Art. VIII.—*Descriptions of new Land Shells.* By Professor F. W. Hutton.

[*Read before the Philosophical Institute of Canterbury, 19th October*, 1882.]

During the last six months I have received many land shells from several friends, but especially from Mr. T. F. Cheeseman of Auckland and Mr. R. Helms of Greymouth, and amongst these shells are the following new species. The most interesting are a species of *Strobila*, a genus hitherto, I believe, known only in America and the West Indies, and two species of *Leptopoma*, a genus of operculated land shells that occurs in New Guinea, Borneo, and the Philippine Islands, but not hitherto recorded from New Zealand.

The dentition of these new species, together with others already described, will form the subject of another paper which I hope to read to the society next year.

Sec. AULACOGNATHA.

Patula tapirina, sp. nov. *P. coma*, Hutton, Trans. N.Z. Inst., xiv., p. 130, pl. 3, fig. l (not of Gray).

Shell subdiscoidal, broadly umbilicated, closely ribbed; colour horny-brown, sub-radiated with reddish spots. Spire very slightly elevated, flat: whorls 5½–6, slowly increasing, rounded, ornamented with narrow oblique ribs, about 16–20 in the tenth of an inch, the interstices indistinctly striated with growth-lines; suture impressed: umbilicus about one-fourth the diameter of the shell, funnel-shaped, gradated, pervious: aperture subvertical, rotundly lunar; peristome thin, upper margin rapidly advancing and then turning down with a slightly concave sinuation, then regularly arched; columellar margin not reflected. Greatest diameter 0·19, least 0·16, height 0·07 inch. *Dentition*, 13–1–13.

Hab. Dunedin.

Having compared this species with specimens of the true *P. coma* from Auckland I find that it is different, being more closely ribbed, but less closely so than in *P. buccinella* and *P. infecta*. The right lip advances, as in *P. infecta*, but it can be distinguished from that species by the interstices between the ribs appearing almost smooth when viewed by transmitted light, and an inch objective.

Microphysa (?) pumila, sp. nov.

Shell minute, subdiscoidal, umbilicated, thin, translucent, smooth, scarcely shining, with distant plait-like ribs: colour horny-brown. Spire slightly convex; whorls 4, increasing rather rapidly, rounded, with regular, distant, membranous ribs, about 20 to 25 in the tenth of an inch, the insterstices finely reticulated; suture impressed; umbilicus rather large, about one-fourth the diameter of the shell, gradated, pervious; aperture

large, rather oblique, subcircular, broader than high; peristome thin, regularly arched, the columellar margin slightly reflected. Greatest diameter 0·07, least 0·055; height 0·03 inch.

Animal.—Body short, eye-peduncles long and thick, tentacles short; mantle rather posterior, enclosed; foot narrow, without locomotive disc, pointed behind, not extending beyond the shell; no caudal gland. Colour pale grey, eye-peduncles and a stripe on each side of the head dark sooty-brown. *Dentition* 13–1–13.

Hab. Eyreton, North Canterbury (Mr. C. Chilton), Christchurch (Mr. J. F. Armstrong).

Genus **Gerontia**, g. n.

Animal heliciform; mantle rather posterior, included; tail acute, with a mucous pore but no papilla. *Jaw* smooth, striated. *Shell* depressed, umbilicated, of about five gradually-increasing whorls; aperture oblique.

This genus differs from *Patula* in having a mucous gland on the tail.

Gerontia pantherina, sp. nov.

Shell subdiscoidal, broadly umbilicated, striated, horny brown. Spire slightly convex, whorls five, slowly increasing, rather flat, with rather close but irregular oblique striæ, which are membranous on the upper surface, interstices not reticulated; suture impressed; umbilicus more than one-fourth of the greatest diameter of the shell, perspective; aperture oblique, rotund, slightly flattened below; peristome thin, the margins rapidly converging; columellar margin not reflected.

Greatest diameter 0·37, least 0·33; height 0·16 inch. *Teeth,* 18–1–18.

Animal.—Top of the head yellow; peduncles and a line on each side of the head black, rest of the body pale grey spotted with dark grey, the spots often collected into groups, a regular line of dark grey spots runs along each side, and they meet on the tail just over the mucous pore; below this line the side of the foot is marked with oblique dark stripes; sole white, the margin with grey spots.

Hab. Greymouth (Mr. R. Helms).

Strobila leiodus, sp. nov.

Shell minute, subdiscoidal, umbilicated, ribbed; colour horny with longitudinal bands of pale rufous. Spire almost flat, but very slightly convex; whorls five, very slowly increasing, rounded, with numerous oblique narrow ribs, about thirty in the tenth of an inch, the interstices finely striated with growth-lines; suture impressed: umbilicus rather narrow, about one-sixth the diameter of the shell, nearly cylindrical, margined with brown: aperture vertical, rather narrow, lunate; peristome simple, thin, the right lip at first ascending, then descending and sweeping forwards, leaving a shallow posterior sinus, afterwards regularly arched, columellar

margin shortly ascending, rather straight, and slightly reflected over the umbilicus: interior of the aperture strengthened with seven spiral plaits on the body-whorl, and another, rather distant, on the columella; parietal wall with ten spiral plaits. Greatest diameter 0·08, least 0·07; height 0·05.

Animal.—Body elongated, narrow; eye-peduncles long and thick, tentacles moderate: mantle subcentral, rather anterior, enclosed: foot very long and narrow, with neither locomotive disc nor caudal gland. Colour pale grey, eye-peduncles and a stripe on each side of the head purplish; foot pale brown. *Dentition*, 12–1–12.

Hab. Greymouth (Mr. R. Helms).

Amphidoxa cornea, sp. nov.

Shell thin, depressed, imperforate, striated, translucent; colour pale horny. Spire slightly convex; whorls 2½, rapidly increasing, rounded, smooth, polished, finely striated with growth-lines; suture impressed: aperture very oblique, transversely oval; peristome thin, regularly arched, columellar lip slightly reflected. Greatest diameter 0·25, least 0·2. *Dentition*, 17–1–17.

Hab. Auckland (Mr. T. F. Cheeseman).

From *A. compressivoluta* this shell may be distinguished by the whorls being convex instead of flattened; from the other New Zealand species of *Amphidoxa* by being imperforate, and of a pale horny colour without markings and without ribs. The mantle of the animal is marbled with black, which shows through the shell.

Amphidoxa costulata, sp. nov.

Shell small, subdiscoidal, umbilicated, shining but not polished, ribbed; colour pale horny, longitudinally banded with reddish, the bands absent on the last half of the last whorl. Spire almost flat; whorls 3½, rapidly increasing, rounded, ornamented with fine spiral striatulations and close ribs, about 40 to 45 in the tenth of an inch, the interstices very finely reticulated; suture impressed; umbilicus a narrow perforation at the bottom of a broad funnel-shaped depression, which is ribbed like the rest of the whorls; aperture oblique, transversely ovate; peristome thin, regularly arched. Greatest diameter 0·14, least 0·1. *Dentition*, 14–1–14.

Hab. Auckland (Mr. T. F. Cheeseman).

This species is easily distinguished by the ribbing and spiral striatulations.

Phrixgnathus, gen. nov.

Animal heliciform. Mantle subcentral, protected by an external shell, over which it is reflected anteriorly. No locomotive disc to the foot. Foot rounded posteriorly and without caudal gland. *Jaw* papillate, imbricately folded. *Teeth* quadrate, the laterals bicuspid. *Shell* conical or turbinated, of five or six gradually increasing whorls; peristome thin, straight.

This genus includes *Helix fatua*, Pfr. (see Trans. N.Z. Inst., xiv., p. 153) and the following species.

PHRIXGNATHUS MARGINATUS, sp. nov.

Shell small, conical, umbilicated, striated: colour pale horny-brown regularly longitudinally banded with reddish-fulvous, the fulvous bands becoming obsolete near the mouth, base pale horny-brown. Spire conical, slightly acute; whorls 5½, flattened, sharply keeled; the first and a half whorls smooth, but spirally striated, the rest longitudinally striated with growth-lines; base slightly convex, radiately striated, and very delicately spirally striatulated; periphery sharply keeled; suture marginated; umbilicus narrow, about one-tenth of the diameter: aperture vertical, rhomboidal; peristome thin, the outer and inner margins nearly parallel, columellar margin slightly reflected. Greatest diameter 0·15, least 0·13; height 0·1 inch.

Animal small, eye-peduncles long, the tentacles moderate; body elongate, foot slightly produced behind beyond the shell. Colour pale-yellowish; peduncles, a stripe on each side of the head, and another short stripe in the middle on each side of the foot purplish gray. *Dentition*, 40–1–40.

Hab. Greymouth (Mr. R. Helms).

Sec. OXYGNATHA.

THALASSIA (?) PROPINQUA, sp. nov.

Shell depressed, striated, narrowly umbilicated; colour pale-horny with numerous narrow zig-zag red bands, which are often broken up into a series of spots. Spire convexly conoidal, apex obtuse; whorls 4–5, rather flattened, the first two smooth, the rest very strongly striated with oblique growth-lines; last whorl carinated, the base rounded; suture impressed: umbilicus narrow: aperture oblique, rotundly lunate, anteriorly subangled; peristome thin, the columellar margin reflected. Greatest diameter 0·24, least 0·2, height 0·16 inch. *Dentition*, 21–1–21.

Hab. Weka Pass (C. Chilton).

Allied to *T. zealandiæ*, but less acutely keeled, more strongly striated and differently coloured; its generic position is doubtful.

ZONITES (?) HELMSI, sp. nov.

Shell depressed, umbilicated, finely ribbed, rather shining; colour horny-brown, sometimes longitudinally banded or spotted with red-fuscous. Spire convex, depressed obtuse; whorls 5½–6, slowly increasing, rounded, broader than high, ornamented with thin rather distant ribs, about 10 to 15 in the tenth of an inch, the insterstices finely reticulated; suture impressed; umbilicus narrow, about one-seventh of the greatest diameter of the shell, open, perforate: aperture oblique, lunately rotund; peristome thin, regularly arched, the columellar lip scarcely reflected. Greatest diameter 0·35, least 0·3, height 0·28 inch.

Animal.—Body elongated, the eye-peduncles long and thick, tentacles moderate; foot very long and narrow, compressed, not tapering, truncated posteriorly and with a caudal gland; mantle slightly reflected. Colour variable—(*a.*) Entirely slate-grey, or reddish-brown, (*b.*) upper parts slate-grey, foot yellowish speckled or marbled with grey, (*c.*) white with a few black spots, the upper anterior parts of the body, except a pale band on the top of the head, slate-grey.

Dentition, 25–1–25. Jaw ribbed.

Hab. Greymouth, sent by Mr. R. Helms, after whom I have much pleasure in naming it.

ZONITES (?) FULMINATA, sp. nov.

Shell depressed, very narrowly umbilicated, striated; colour pale horny with numerous longitudinal zig-zag red bands on the body-whorl, which show only as irregular radiating bands on the spire. Spire slightly convex; whorls 5½, slowly increasing, rounded, smooth, with a fine striation of growth-lines; suture impressed; umbilicus very narrow, almost covered up by the reflected columellar margin of the peristome; aperture subvertical, transversely lunately rotund; peristome thin, regularly arched, columellar lip callous, reflected. Greatest diameter 0·34, least 0·27, height 0·23.

Dentition, 38–1–38. Jaw ribbed.

These two species differ from *Zonites* in the jaw, I propose to put them in a new genus to be called *Phacussa.*

This species appears to approach *H. venulata*, Pfeiff., which I have not seen; but that shell is said to be imperforate, downy, and differently coloured from this one.

Hab. Stewart Island (Mr. T. Kirk, a single specimen).

Sec. AGNATHA.

RHYTIDA PATULA, sp. nov.

Shell depressed, umbilicated, thinnish, translucent, scarcely shining, finely malleated; colour brown, yellowish at the apex. Spire rather convex, obtuse; whorls 3½–4, rapidly increasing, rounded, the first 2¼ transversely plaited, the remainder with numerous small longitudinal depressions, and a few obsolete broad spiral grooves near the periphery; under the lens finely spirally striated; last whorl very large, the last quarter occupying more than half the diameter of the shell, the base evenly rounded; suture impressed: umbilicus rather narrow: aperture very large, oblique, oblong-oval; peristome slightly thickened, the right margin descending, columellar margin reflected over the umbilicus, but not covering it. Greatest diameter 0·9, least 0·63; height 0·4; breadth of aperture 0·5.

Animal.—Foot broad, flattened, and acutely pointed behind, the margin minutely crenulated, tail extending beyond the shell; no caudal gland, nor

locomotive disc. Mantle subcentral just reflected over the peristome. Eye-peduncles separated at their bases, they and the tentacles long, stout, and cylindrical. Head, peduncles, and anterior part of the foot dark grey closely reticulated with blue-black lines, and with scattered minute white specks; sole of the foot dark-coloured; mantle under the shell pale yellow, with blotches of blue-black which show through the shell. *Dentition*, 18–0–18.

Hab. Greymouth (Mr. R. Helms).

When the animal is alive the peristome of the shell is yellow, but it soon fades.

Rhytida citrina, sp. nov.

Shell depressed, umbilicated, malleated, thin, translucent, shining; colour pale yellow, sometimes with a spiral brown band on the middle of the upper portion of the whorl. Spire very flatly convex, apex obtuse; whorls three, rapidly increasing, rounded; the first two whorls slightly longitudinally plaited, the last above with numerous small irregular indentations, below rounded, smooth, striated with growth-lines in the umbilicus; suture impressed: umbilicus rather narrow: aperture oblique, broadly oval; peristome very thin (not adult?), with the columellar margin reflected. Greatest diameter 0·31, least 0.24; height 0.24; breadth of aperture 0.16 inch. *Animal* pale brown, the upper surface with the peduncles and tentacles dark sooty black, with a pale band on the top of the head; sides of the foot marbled with sooty black. *Dentition*, 17–0–17.

Hab. Greymouth (Mr. R. Helms).

It is hardly possible that this shell can be the young of *R. patula*, because the markings on the shell, the colours of the animal, and the dentition all differ.

Rhytida australis, sp. nov.

Shell depressed, umbilicated, rather thin, translucent, malleated; colour pale horny-brown, the umbilicus darker, the first 2¼ whorls yellowish; sometimes a pale spiral yellow band on the base. Spire flatly convex, obtuse; whorls 3½ rapidly increasing, rather flattened; above with numerous irregular shallow indentations sometimes arranged in oblique lines, the first 1½ whorls smooth, the next obliquely plaited, the plaits gradually dying away but remaining longest at the suture; base rounded, smooth, shining, striated in the umbilicus with growth-lines; suture impressed: umbilicus rather narrow: aperture oblique, oval; peristome very slightly reflected over the umbilicus (not quite adult). Greatest diameter 0·43, least 0.33; height 0·25; breadth of aperture 0.2 inch. *Dentition*, 16–0–16.

Hab. Stewart Island (Mr. T. Kirk).

The shell can be distinguished from that of *R. greenwoodi* by the base being rounded.

Testacella vagans, n. s. = *Daudebardia novæ-zealandiæ*, Trans. N.Z. Inst., xiv., p. 152 (not of Pfeiffer).

Shell auriform, subspiral, depressed, imperforate; elongately oval, the sides nearly parallel, the anterior end rather broader than the posterior; columellar margin callous; apex subspiral, posterior; pale horny, striated with growth-lines. Length of aperture 0·37; breadth 0·22. *Teeth*, 15–0–15.

Animal (in spirit) above slate grey, gradually passing into yellowish white on the sides; sole yellowish white; the sides rather marbled with grey.

Hab. Auckland (T. F. Cheeseman), and Waiuku (T. Kirk).

The specimen described in the Trans. N.Z. Inst. for last year was without its shell, and consequently I thought that it was *Daudebardia novæ-zealandiæ*, the shell but not the animal of which species I know, but Mr. Cheeseman has sent me a specimen with the shell on, and it proves to be quite different. The shell is much like that of *T. mangei*, but the dentition appears to be different.

Sec. NEUROBRANCHIATA.

Leptopoma pannosa, sp. nov.

Shell conical, subcarinated, umbilicated, brown, covered with a dark fuscous, ragged epidermis. Spire acutely conical; whorls six, rather flattened, the last convex below and rounded at the angle; apical whorls showing close oblique growth-lines; base flattish with close growth-lines crossed by delicate spiral striæ; suture impressed: epidermis forming ragged oblique, rather distant plaits on the whorls, and at the periphery produced into triangular pointed processes: umbilicus narrow, open: aperture rather oblique, broadly ovate; peristome thin, regularly arched, or slightly angulated at the periphery, slightly patulous, margins not meeting.

Height 0·13, diameter 0·11 inch.

Operculum thin, transparent, horny, yellow, subcircular, of five gradually enlarging whorls; nucleus subcentral.

Animal like *Cyclostomus;* pale grey, the tentacles darker; rostrum whitish. Tentacles short, rather stout, pointed; eyes large, at their outer bases. *Dentition*, 3–1–3.

Hab. Greymouth, under very damp logs and earth (Mr. R. Helms).

In shape this species is much like *Hydrocæna rubens*, Q. & G. (*Cyclostoma*) from Mauritius, figured in Adams' Genera of Mollusca, pl. 87, fig. 2, but the operculum is quite different.

Leptopoma calva, sp. nov.

Shell conical, reddish brown with a thin spiral pale band below the periphery; spire acutely conical; whorls 6½, rather flattened, the last convex below and rounded: epidermis smooth, forming numerous fine oblique

growth-lines; suture impressed: umbilicus very narrow, but open: aperture, peristome, operculum and dentition like the last species. Height 0·13, diameter 0·08 inch.

Hab. Greymouth, with the last species (Mr. R. Helms).

More acute than the last and not carinated, but perhaps only a variety.

ART. IX.—*On the New Zealand* Siphonariidæ. By Professor F. W. HUTTON.

[*Read before the Philosophical Institute of Canterbury, 1st June,* 1882.]

Plate XVII.

IN this paper I have attempted to give descriptions of the shells and dentition and some notes on the anatomy of all the New Zealand species of *Siphonaria* and *Gadinia* known to me, that is four species of *Siphonaria* and one of *Gadinia*: it will I hope form a basis for a comparison with the species inhabiting Tasmania, Australia, and Polynesia.

Genus **Siphonaria,** *Blainville.*

Shell conical, with an internal siphonal groove on the right side. Head with a frontal bilobed disc; eyes none; pulmonary cavity with a gill lying transversely across the middle; respiratory orifice covered by a fold of the mantle. Jaw horny. Radula long, the teeth quadrate, arranged in very slightly curved transverse rows.

Ova in white gelatinous rope-like masses from an inch to an inch-and-a-half in length, attached to rocks in semicircles or irregular curves. Larva a veliger in a nautiloid operculated shell.

Ova laid early in February.*

SIPHONARIA OBLIQUATA. Plate XVII., figs. A to D.

Siphonaria obliquata, Sowerby, Cat. Coll. Earl of Tankerville, 1825, app. p. 7. Reeve, Conch., Icon., fig. 56.

Siphonaria scutellum, Deshayes in Guerin's Magasin de Zoologie, 1841, pl. 35.

Shell large, oblong, rather depressed, with numerous rather undulating ribs; apex posterior, uncinate. Exterior brown; interior liver-brown, often mottled with yellowish-brown. Length 1·6, breadth 1, height ·5 inch.

Dentition, $\frac{68-1-68}{258}$. Jaw arcuate, expanded at each end, with about five rounded transverse ribs in centre; anterior margin papillate, the rest smooth. Central tooth broad, the breadth being more than half the length; laterals 30 with a unidentate cutting-point on the principal cusp, and a small cutting-point on the outer side which is placed on a small cusp on the more central laterals; marginals nearly square with three cutting-points, the median one large and rounded at the end.

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* The following species are omitted as not really inhabiting New Zealand:—

S. cancer, Reeve; inhabits Formosa. *S. spinosa*, Reeve; habitat unknown.

Animal.—Yellow ochre, spotted with dark purple, sole of the foot yellow. Œsophagus long and narrow, suddenly expanding into the stomach. The intestine, starting a little above the fundus of the stomach, passes anteriorly to the left, crosses over to the right, bends backward, and again crosses over the stomach to the left, and, having reached the fundus, turns sharply forward as a rectum to the anus. The hepatic ducts enter the fundus of the stomach. The salivary glands open into the buccal mass, which is of a blood-red colour, while the salivary glands are yellow. The stomach is pale yellow, with a dead white cæcum at the cardiac end. The liver is yellow-brown. The penis is large and thick, with an orange gland at the end. The ovotestis is yellow-brown, the hermaphrodite duct blue-black, the albumen gland and uterus pale yellow, and the spermatheca red. Numerous particles of calcite are found about the reproductive organs.

Hab. Dunedin; Banks Peninsula; Wellington; and at the Chatham Islands.

Sowerby originally gave Tasmania as the habitat, but it is not mentioned in the Rev. J. Tenison-Wood's Census of Tasmanian Shells. Reeve gives New Zealand as the locality. The identification of *S. scutellum* with this species is due to Dr. E. von Martens; I have not seen Deshayes' description.

Siphonaria australis. Plate XVII., figs. e to g.

Siphonaria australis, Quoy and Gaimard, Voy. Astrolabe, Zool. ii., p. 329, pl. 25, figs. 32-34 (1833); Gray, Figures of Molluscous Animals, pl. 76, fig. 5.

Shell ovate-oblong, rather conical, with numerous unequal rather undulating ribs; apex posterior, not uncinate. Exterior reddish-brown, the ribs white; interior liver brown, the margin generally marked with white at the termination of each rib. Length ·75; breadth ·5 to ·6; height ·25 inch.

Dentition, $\frac{36-1-36}{160}$. Jaw arcuate, of equal thickness throughout, rounded at each end, concave margin papillate, remainder of surface obliquely cross striated in two directions. Central tooth rather narrow, its length being nearly three times the breadth of the base. Laterals about 19, they and the marginals much like those of *S. obliquata.*

Animal pale-yellowish, speckled with black on the sides of the foot and head. Alimentary system like the last species, but the œsophagus is short and passes gradually into the stomach, which is yellowish-white. The liver is pale yellow. The penis is long and narrow, the gland pale yellow. The ovotestis is brownish-yellow, and the spermatheca narrow.

Hab. Abundant on rocks in the south as far as Banks' Peninsula; rare in Cook's Straits. Quoy's specimens were obtained on the roots of kelp.

This species is closely allied to *S. diemenensis*, Quoy and Gaimard, and may prove to be a variety of it; in which case I would ask Australian conchologists to retain our name, as the more appropriate. Further notes on its anatomy and development will be found in the Annals of Natural History for 1882.

SIPHONARIA ZEALANDICA. Pl. XVII., figs. H to M.

Siphonaria zealandica, Quoy and Gaimard, Voy. Astrolabe, Zoologie ii., p. 344, pl. 25, fig. 17-18 (1833).

Shell ovate-oblong, depressed with numerous rounded ribs, of which about fourteen are usually much larger than the others, two of these close together form the siphonal groove, and are separated by a considerable space from the other larger ribs. Apex obtuse, submedian. Exterior ash-brown, the ribs sometimes lighter; interior liver-brown, the apex often yellowish, a narrow marginal line, or often only the tips of the projecting ribs, yellowish. Length ·75; breadth ·6; height ·15 to ·2 inch.

Dentition, $\frac{33\text{ to }40-1-33\text{ to }40}{130\text{ to }140}$. Jaw like that of *S. australis*. Central tooth narrow, its length three times the breadth at the base. Laterals about thirteen, the cutting-point bidentate, and a small cutting-point on the outside; marginals with three cutting-points, the median the largest, and bidentate on the inner marginals, simple and rounded on the outer ones.

Animal like *S. australis*, but the ovotestis is pale yellow.

Hab. Auckland, Nelson, and Wellington; comparatively rare and very small at Banks' Peninsula, which is the most southern locality at which I have found it. Chatham Islands (?).

This species is usually easily recognized from the last by its large projecting ribs, but sometimes the shells cannot be distinguished, and the bidentate cutting-points of the teeth is the only reliable character. *S. inculta*, Gould, is probably the same, but I have not seen the figure. Reeve has identified *S. zealandica* with *S. sipho*, Sowb., found in the Indian Archipelago; perhaps he is right, but until the dentition of *S. sipho* is known it will be better I think to keep the two separate.

SIPHONARIA REDIMICULUM. Plate XVII., figs. N. to R.

Siphonaria redimiculum, Reeve, Conchologia Iconica, Siphonaria, fig. 24.

Shell ovate-oblong, depressed, rather thin, with about twenty-five distant undulating ribs; apex posterior, uncinate, bent to the left; exterior uniform reddish-brown; interior dark purple, lighter under the apex.

Length ·8–·9; breadth ·65; height ·2.

Dentition, $\frac{44-1-44}{120}$. Jaw arcuate, tapering to each end; surface covered with minute papillæ. Central tooth very narrow, its length being four times the breadth. Laterals about twenty, the cutting-point bidendate and continued down on each side of the cusp; interior marginals with two cutting-

points, the inner larger and simply rounded at the end; exterior marginals with three cutting-points, the median the largest and rounded at the end.

Animal dark blue-black, sole of the foot yellowish. Œsophagus long, narrow, and expanding suddenly into the stomach; the intestine turns forward to the left and passes round the aorta as in other species of the genus, and its folds are much the same as in *S. zealandica*. The salivary glands are elongated and connected together below the œsophagus. The heart is pale yellow and situated on the left side. The penis is thick: the ovotestis pale yellow. The nerve-collar is asymmetrical, the pedal, and more especially the parieto-splanchnic ganglia being drawn over to the right side; there is an auditory vesicle on each of the pedal ganglia.

Hab. Auckland Islands.

Reeve gives no locality for this species, but it has since been identified as coming from Kerguelen's Land; our species may prove to be distinct.

Genus **Gadinia**, *Gray*.

Shell conical, with a slight internal siphonal groove in front of the right side of the muscular impression. Head distinct; tentacles, expanded funnel-shaped; pulmonary cavity with a gill placed obliquely across the back of the neck. Jaw none. Radula rather short, teeth quadrate, arranged in angled transverse rows.

Gadinia nivea. Plate XVII., figs. s. to v.

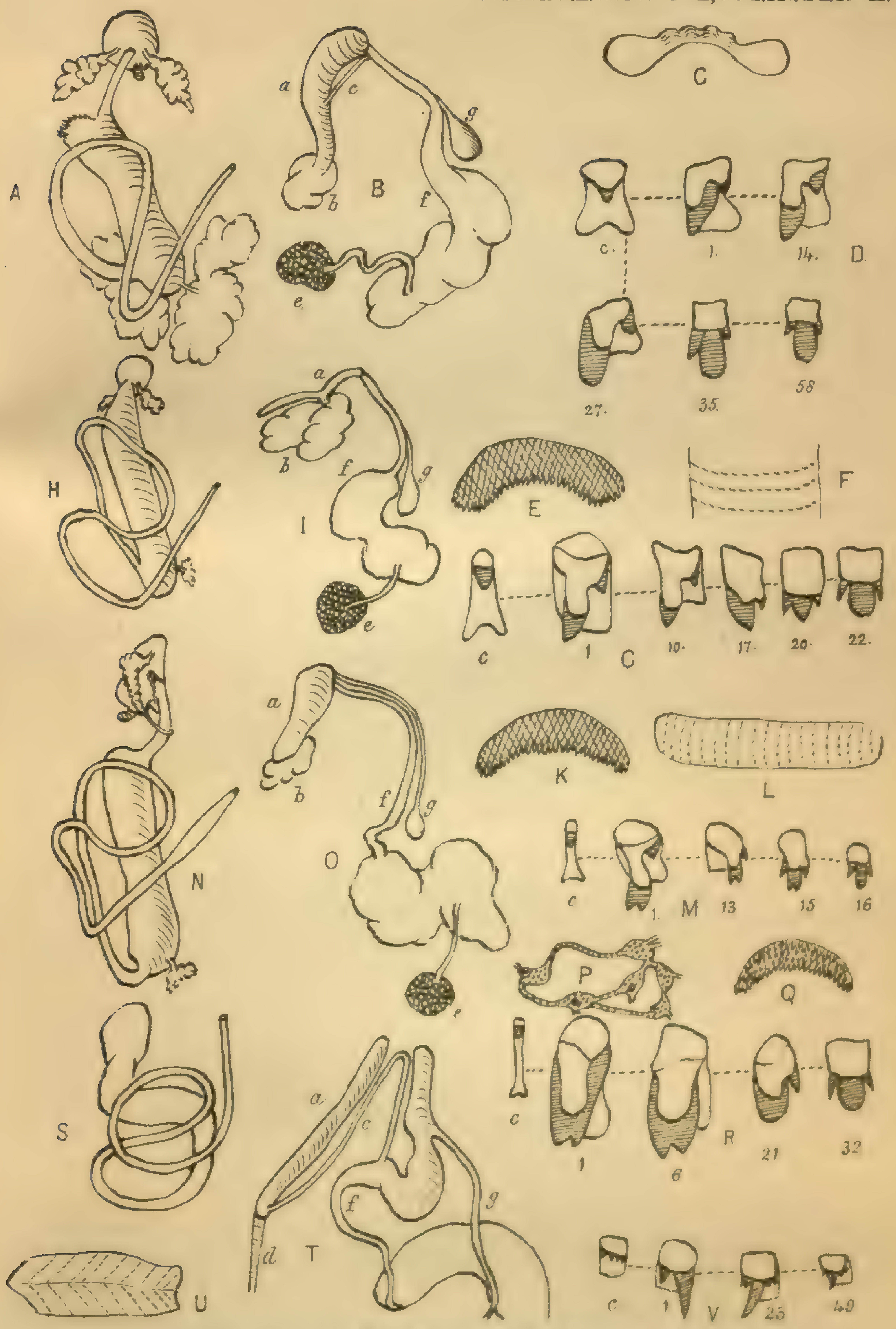
Gadinia nivea, Hutton, Jour. de Conchyliologie, 1878, p. 36.

Shell ovate, depressed, white, with about forty radiating ribs; apex rather posterior, slightly uncinate.

Length ·75 or ·8, breadth ·7, height ·15 to ·2.

Dentition, $\frac{60-1-60}{150}$, transverse rows forming an angle of about 90°, re-entrant anteriorly. Jaw none. Central tooth with the reflexed portion somewhat rectangular with four minute denticles on the oblique posterior edge. Laterals about twenty-one, each with a long pointed cutting-point and a small denticle on the inner side. Marginals with a long median cutting-point and two small denticles on each side.

Animal probably white, but the only specimen I have had, had been for some time in spirit and was not in good condition. Buccal mass very large and oval; œsophagus short and as broad as the stomach, which turns sharply to the right and passes gradually into the intestine. The intestine passes backward, then curves to the left, then forward and to the right passing over the pyloric end of the stomach, it then makes a complete circle forward and to the left, and then passes straight to the anus which is on the right side of the head. The reproductive orifice is situated between the anus and the mouth. The penis is long, narrow, and straight, lying



To illustrate Professor Hutton's paper on
THE NEW ZEALAND SIPHONARIDÆ.

obliquely across the body, its retractor muscle is attached to its posterior end and arises from the left posterior portion of the foot. The ovotestis and spermatheca were not seen, but the peduncle of the latter is long and opens into the vagina at some distance from the reproductive orifice. The vas deferens leaves the oviduct about half way down, passes forward almost as far as the reproductive orifice and then bends sharply backward opening into the posterior end of the penis.

Hab. Dunedin and Shag Point, on rocks and on the roots of *D'Urvillæa utilis.*

EXPLANATION OF PLATE XVII.

A.	*Siphonaria obliquata.*	Alimentary system.
B.	,, ,,	Reproductive system.
C.	,, ,,	Jaw × 6.
D.	,, ,,	Teeth × 190.
E.	*Siphonaria australis.*	Jaw × 13.
F.	,, ,,	Portion of radula × 11.
G.	,, ,,	Teeth × 315.
H.	*Siphonaria zealandica.*	Alimentary system.
I.	,, ,,	Reproductive system.
K.	,, ,,	Jaw × 22 (small specimen).
L.	,, ,,	Radula × 11.
M.	,, ,,	Teeth × 315.
N.	*Siphonaria redimiculum.*	Alimentary system.
O.	,, ,,	Reproductive system.
P.	,, ,,	Nervous system.
Q.	,, ,,	Jaw × 8.
R.	,, ,,	Teeth × 315.
S.	*Gadinia nivea.*	Alimentary system.
T.	,, ,,	Reproductive system (portion only).
U.	,, ,,	Radula × 10.
V.	,, ,,	Teeth × 315.

Reference to Letters on Reproductive Systems.

a, Penis.—*b*, accessory gland.—*c*, vas deferens.—*d*, retractor of penis.—*e*, ovotestis. —*f*, oviduct.—*g*, spermatheca. The numbers under the teeth signify the number of the tooth from the central one, which is marked *c*.

ART. X.—*Additions to the Isopodan Fauna of New Zealand.*

By CHARLES CHILTON.

[*Read before the Philosophical Institute of Canterbury, 6th April,* 1882.]

Plate XVIII.

WHILE staying for a few days at Timaru during the last Christmas holidays I contrived to collect a few small Crustacea from amongst the seaweed that is exposed at low tide, just at the north side of the breakwater.

Among these was one belonging to the very remarkable genus *Apseudes*. Of this genus there are two species given in Bate's and Westwood's "British Sessile-eyed Crustacea," and Mr. Haswell has lately described one from Australia,* but the animal I have does not belong to either of these three species.

For the sake of those who may not be able to consult Bate's and Westwood's book, I transcribe the generic characters.

Genus **Apseudes,** *Leach.*

(Bate's and Westwood's "British Sessile-eyed Crustacea," vol. ii., p. 144.)

"Body elongated. Head and first segment of the pereion confluent. Upper antennæ longer than the lower, with the first joint of peduncle long and robust, the flagellum consisting of two elongated articulated filaments. First pair of gnathopoda chelate; second pair having the propodos transversely dilated. Pleon terminated by a large segment bearing two long and two short slender filaments."

Apseudes timaruvia, sp. nov. Pl. XVIII.

Front of cephalon broad, with a slight projection in the centre, and produced into a sharp point immediately in front of the eyes. Eyes small. Upper antennæ with the basal joint of peduncle very large and strong, with a prominence on the inside; second joint fully twice as long as the third. Flagellum not so long as peduncle, secondary flagellum rather more than half as long as the primary. First pair of gnathopoda very large and strong, fixed finger with a prominence on its inner surface, and having the end tipped with hairs. Propodos of the second pair of gnathopoda not dilated. Pleon short, sixth segment not longer than the rest together. Terminal tail-legs with the outer branch half as long as the inner.

Colour, light brown.

Length, about ¼ of an inch.

Hab. Timaru.

Of this species I have obtained a single specimen only, but I have examined it with considerable care and made as much as I could out of it, because it belongs to a very remarkable genus of Crustacea. Bate and Westwood in their book on the British Sessile-eyed Crustacea say "this is one of the most interesting genera of Crustaceous animals." This is because it possesses both Isopodan and Amphipodan characters, and also some that belong to the Macroura; the union of the head with the first thoracic segment into a "carapace," and the great chelate gnathopoda make the dorsal view very like that of a Macrourous Decapod.

The animal I have described differs from the other species of the genus in some points, as will be seen from the fuller description given further on,

* Proceedings Linnæan Society of New South Wales, Vol. VI., Part the Second, p. 193.

but it so evidently belongs to the same group, that I have thought it better that the genus should be widened than that matters should be complicated by the addition of a new genus.

In the *upper antenna* (pl. XVIII., fig. 2) the basal joint of the peduncle is very large, and on the inner side, at about one-third of its length from the base, there is a projection (*p*), the edge of which is crenulated. There is a somewhat similar structure in *Apseudes talpa*, but it is not so well marked. The two projections of the two antennæ appear to fit with one another and form a grasping organ of some kind. The second joint of the peduncle is only one-third the length of the first and is slightly expanded distally; it is followed by the third joint, half as long as the second, bearing the *two* flagella. It is, I believe, only in this genus of Isopoda that the upper antenna has two flagella, though it is common enough among the Amphipoda.

The secondary (inner) flagellum is half as long as the primary one, and consists of about six joints, the primary flagellum having about fourteen. On the primary one several of the joints bear longish simple setæ, and a single auditory cilium at their distal ends (fig. 2 *a*).

In the *second antenna* (pl. XVIII., fig. 3) four joints can be distinguished in the peduncle, possibly there is another joined to the head. From the first of these joints there springs a small projection ending in a very long seta; this may possibly correspond to the "olfactory denticle" of Spence Bate, which is so common among the Amphipoda. The last joint of the peduncle is about as long as the two preceding together and is followed by the flagellum, which contains about eight joints bearing long ciliated setæ. In other species of *Apseudes* the inferior antenna bears a small oval squamose plate on the peduncle, something like that found in the Macroura, but I have not been able to find any similar structure in my species.

The *mandible* (pl. XVIII., fig. 4) is large and powerful, besides the teeth on the fixed portion there are also some on the end of a large piece which projects from about the middle and appears to be movable. The appendage consists of two joints, though there may also be another close down to the mandible itself. The second last joint is the longest and bears several short setæ, the last joint narrows towards the end and bears several short and two or three long setæ.

As I have only had a single specimen I have not been able to make out all the mouth-parts satisfactorily; the one represented in fig. 5 I believe to be the *second maxilla*, or perhaps only part of it. It consists of two pieces, one narrows towards the distal end, which bears a crown of strong setæ; the other springs as an appendage from the base of the first, it also narrows towards the end, this is covered with very short hairs and bears four very

long divergent setæ. This appendage to the second maxilla appears to be the homologue of a similar appendage to the second maxilla of *Tanais*, as described by Fritz Muller* and figured by Dr. MacDonald.†

The *maxillipedes* (pl. XVIII., fig. 6) are rather long: the first joint is short, the next is much larger and longer and, I believe, bears an appendage. The third joint is broader than long, while the fourth is much longer than broad and has the inner side fringed with setæ. The two terminal joints are seen partially in profile in fig. 6, but in fig. 6 *a.* they are seen full on; they both bear several long setæ, each of which is serrated on one side only.

The first thoracic segment is so closely joined to the head that the line of junction cannot be seen; the second thoracic segment is more closely united to the "carapace" thus formed than the other thoracic segments are to one another.

In the other species of *Apseudes* the eyes are pedunculated like those of the Podophthalmous Crustacea, but in this species they are very small, and there is no sign of any peduncle.

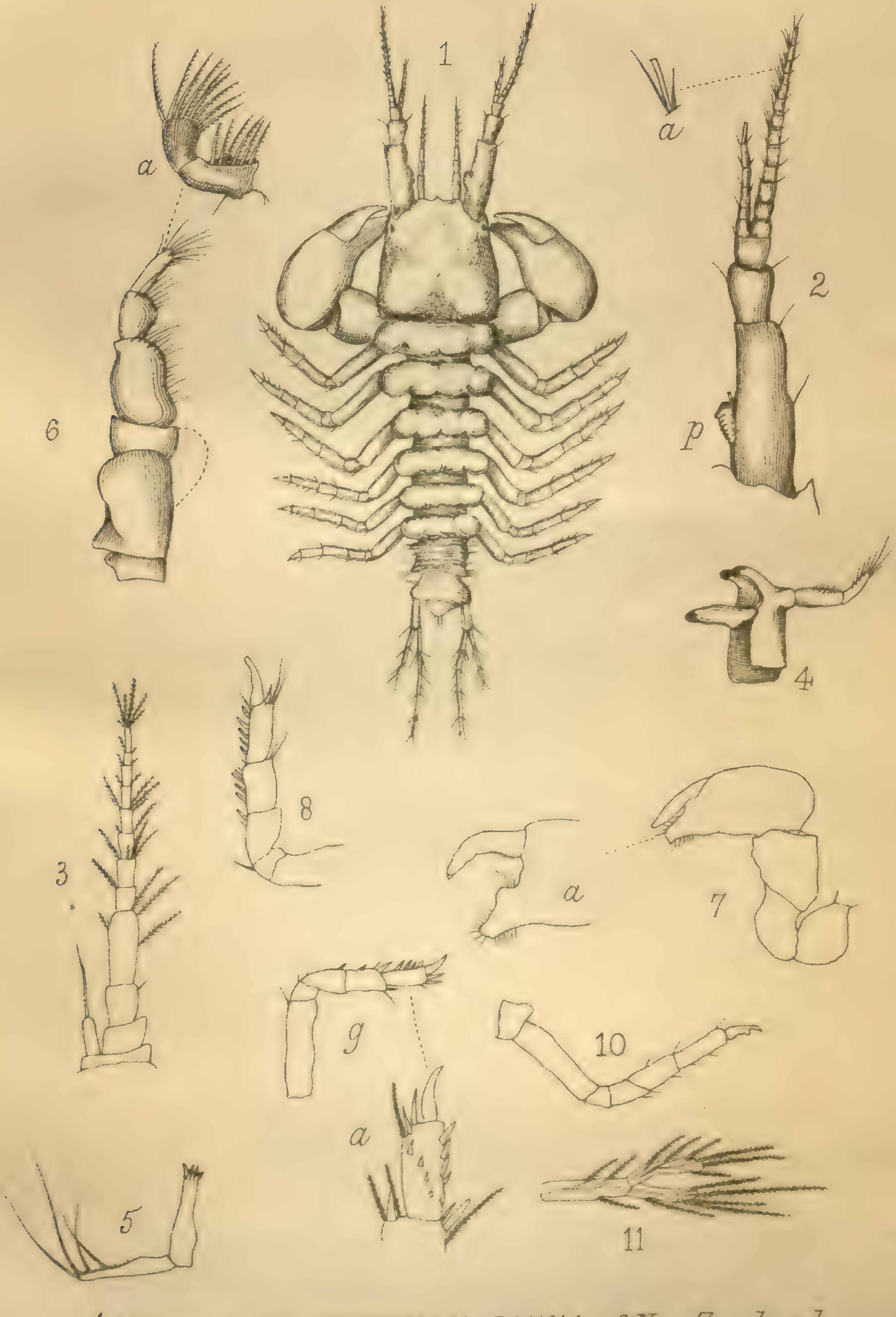
The *first pair of gnathopoda* (pl. XVIII., fig. 7) are very large. The carpus and propodos are the two largest joints, the propodos being especially large; it is produced into a strong blunt finger, which has a rounded prominence at the middle of its inner side, and bears several short stiff-looking setæ at the end. The movable finger is strong, curved, tipped with brown at the end, and somewhat roughened on the inside. In conjunction with the fixed finger it forms a very powerful chela.

In all other species of *Apseudes* that I know of, the propodos of the *second gnathopod* is transversely dilated; this is, indeed, given by Mr. Spence Bate as a generic character, but in my species the second gnathopod (pl. XVIII., fig. 8) differs from the other thoracic legs only in being very slightly larger. The carpus is broader than the propodos; both bear stout spines on their inner edge, and there is one spine and two or three long hairs at the base of the terminal finger. The third pair of thoracic legs differ from the second only in being very slightly smaller and in having a few more spines and hairs. The hairs are plumose. Fig. 9*a* shows the arrangement of these spines and hairs. The succeeding legs are of the small general shape, but the spines gradually disappear, until in the last pair (fig. 10) there are none at all; the terminal finger also differs in having prominences on its inner edge.

The *pleon* is very short. I have not been able to make out the divisions between the segments, but it is evident that the first five segments must be

* "Facts and Arguments for Darwin," p. 17.

† "On the External Anatomy of *Tanais vittatus*."—Transactions of the Linnæan Society, Second Series, Zoology, vol. i., p. 67, pl. xv., fig. vi.*d*.



C.C. del. *Additions to the ISOPODAN FAUNA of New Zealand.*

very short, almost linear transversely, and although the sixth is larger, it also is, I think, broader than long and not so long as the others together. In other species of *Apseudes* the sixth segment of the pleon is longer than the preceding five together.

The tail-piece is triangular and is tipped with two or three short setæ. In the terminal tail-legs the outer branch is one-half as long as the inner and both bear long straggling setæ.

The other appendages of the pleon appear to be about midway in structure between the first three pleopoda of the Amphipoda and the branchial pleopoda of the Isopoda. They (pl. XVIII., fig. 11) are small and each consists of a narrow basal-joint followed by two equal branches, the whole bearing long ciliated setæ. They differ from the first three pairs of pleopoda of the Amphipoda only in the fact that the branches are not divided into many joints, in fact they resemble them so much and differ so much from the branchial sacs of the typical Isopoda that I think they cannot be used as respiratory organs. The possession of the appendage to the second maxilla points to the fact that respiration must be carried on at the sides of the head, as is stated by Fritz Muller to be the case with *Tanais*.

I have taken, both on the banks of the Avon, Christchurch, and at Eyreton, specimens of a small terrestrial Isopod that I at first took to be an *Oniscus*. I have however found that it cannot be distinguished in any specific character from *Philongria rosea*; I have therefore to record the occurrence of this species in New Zealand.

I give the generic and specific descriptions.

Genus **Philongria,** *Kinahan.*

(Bate's and Westwood's "British Sessile-eyed Crustacea," vol. ii., p. 451.)

Generic character.—"Ovate, subdepressed. Cephalon without frontal or lateral lobes. Outer antennæ 9- or 10-jointed, with the second joint cylindrical; terminal joints subulated. Coxæ of first and sixth rings of pleon obsolete. Uropoda entirely exserted; basal portion trigonate. Outer ramus elongate, pointed, and exserted obliquely. Inner narrow, extending beyond the middle of outer, pointed."

Philongria rosea (loc. cit., p. 460).

Specific character.—"Ovate scabrous, covered with small tubercles. Eyes small. Inner antennæ conspicuous. Outer antennæ with the flagellum slender, with apparently only four articuli, which are very difficult to detect except under a strong lens; tipped with a pencil of hairs. Terminal segment of the pleon with the extremity truncated straight. Colour reddish, with whitish spots and dorsal line.

"Length, three-twentieths of an inch."

Hab. Christchurch and Eyreton. In damp situations, under decaying leaves, etc.

This species must, I suppose, have been introduced in some way from England, though there are difficulties in this belief, for I have found it abundantly at two places several miles apart, separated by rivers over which animals of this kind cannot easily cross, and, moreover, it does not appear to be widely distributed in England, for Bate and Westwood say (p. 461):—"We believe that this species has only hitherto been found in Mr. C. Spence Bate's courtyard and cellar, and that of the neighbouring houses, at Plymouth, where it is tolerably abundant."

I have, however, no doubt that my specimens cannot be distinguished specifically from *Philongria rosea*, and we must therefore await further information before we can decide whether it has been introduced or not.

EXPLANATION OF PLATE XVIII.

Apseudes timaruvia.

Fig. 1. Dorsal view × 14.
2. Upper antenna × 34. *p*, the crenulated process on the basal joint. *a*, setæ and auditory cilium from one of the joints of flagellum, more highly magnified.
3. Lower antenna × 60.
4. Mandible × 34.
5. Second maxilla × 40.
6. Maxillipede × 60. *a*, last two joints seen full face.
7. First gnathopod × 14. *a*, part of the same showing the shape of the fingers.
8. Second gnathopod × 24.
9. Third thoracic leg × 19. *a*, end of the same × 40.
10. Last (seventh) thoracic leg × 19.
11. Pleopodum × 60.

Art. XI.—*On some Points of Difference between the English Crayfish* (Astacus fluviatilis) *and a New Zealand one* (Paranephrops setosus). By Charles Chilton, M.A.

[*Read before the Philosophical Institute of Canterbury, 6th July,* 1882.]

Plates XIX.–XXI.

The following paper is an attempt to contrast the structure of the New Zealand crayfish, *Paranephrops setosus*, with that of the English one, *Astacus fluviatilis*, as it is described by Professor Huxley in his recent book "The Crayfish." *

In Miers' "Catalogue of the Stalk- and Sessile-eyed Crustacea of New Zealand" three species of *Paranephrops* are described as belonging to New Zealand. These are *P. planifrons*, *P. setosus*, and *P. zealandicus*. Of these

* International Scientific Series, vol. xxviii.

I have seen *P. setosus* only. *P. planifrons* is a perfectly distinct species, and is found abundantly in many places in the North Island of New Zealand. *P. setosus* is not known to occur in the North Island, but it is widely distributed in the South Island, being found in the River Avon, Christchurch, from which the specimens for this paper were obtained, and also in the rivers near Invercargill, at the south of the island. Thus *P. planifrons* appears to be confined to the North Island, and to be represented in the South Island by *P. setosus*.

P. zealandicus was described as belonging to New Zealand by White in 1847,* but it does not appear to have been since recognized. Professor Hutton, who at the time when he described *P. setosus* in 1873† had no opportunity of consulting White's description, tells me that he thinks it very probable that *P. zealandicus* is nothing more than a young specimen of *P. setosus*. From the comparison of the two descriptions in Miers' Catalogue, and from the figure in the Zoology of the Voyage of the Erebus and Terror, this appears very likely to be the case, and it also agrees well with the small size of *P. zealandicus* (3 inches) as compared with that of *P. setosus* ($5\frac{3}{8}$ inches).

With regard to *P. zealandicus*, Mr. Miers says:‡ "This species is certainly distinct from *P. setosus*, Hutton. In *P. zealandicus*, of which the type specimens are in the British Museum Collections, the hands are clothed externally with tufts of hair arranged in longitudinal series, and are armed with spines only upon the superior margins, and the sides of the carapace are smooth. In *P. setosus* there are spines arranged seriately upon the external surface as well as the upper margin of the hand, and the branchial and hepatic regions of the carapace are armed with numerous inequal conical spines." The first point will certainly not serve to distinguish the two species, for there are tufts of hair on the hand of *P. setosus*, there having been a slight mistake in Professor Hutton's description (see below). With regard to the other points they are certainly subject to some variation in *P. setosus*, and it is quite possible that the spines on the hands and on the sides of the carapace may be developed only in the older specimens, but I have not been able to examine a sufficiently large number of specimens to give a decisive answer on this point. However, there are certainly only the two species, *P. planifrons* and *P. setosus*, known to New Zealand collectors, and this leads one to think either that *P. zealandicus* is not a distinct species or that the locality given is wrong, and that it belongs to Fiji, where a species of *Paranephrops* is found.§

* Proc. Zool. Soc, p. 123.

† Ann. & Mag. Nat. Hist., ser. 4, xii., p. 402.

‡ Ann. & Mag. Nat. Hist., ser. 4, vol. xviii., 1876, p. 412.

§ Huxley, "The Crayfish," p. 306.

The most important result arising from the examination of *Paranephrops setosus* is that its affinity to *Palinurus* now seems to be placed beyond doubt. *Paranephrops* and the *Parastacidæ* generally resemble the *Palinuridæ* in that they have no appendages upon the first abdominal segment; in this they differ from the crayfishes of the Northern Hemisphere, and from *Homarus* and *Nephrops*. The *Palinuridæ* and the *Parastacidæ* also agree in having hooked setæ,* while in the *Potamobiidæ* and in the lobsters the setæ are not hooked. Moreover the branchial formulæ of *Palinurus* and and *Paranephrops* are almost identical. Taking the presence or absence of the first abdominal appendages as the basis of his classification, Professor Huxley placed the *Palinuridæ* and the *Parastacidæ* together as the *Astyla*, while the *Potamobiidæ*, *Homaridæ*, etc., together form the *Stylophora*. This classification is confirmed by the structure of the male reproductive organs in *Paranephrops setosus*, for these agree in every essential particular with those of *Palinurus vulgaris* as described by Brocchi.† In both the testes consist of two long tubes united towards their anterior ends by a commissure; both have long convoluted vasa deferentia; and in both the extremities are greatly expanded. This would appear to be the oldest and most generalized form of the male reproductive organs of crayfishes, New Zealand having preserved the old form in this as in many other cases. In *Astacus fluviatilis* the testes are very different in shape; they are trilobed, two lobes being directed anteriorly, and one posteriorly: thus the two posterior portions, which in *Paranephrops* and *Palinurus* are quite distinct, appear in *Astacus fluviatilis* to have coalesced into a single mass. The vasa deferentia of *Astacus* are much convoluted, but their extremities are not expanded or at least only slightly so. Professor Huxley gives them without any expansion,‡ but in Milne-Edwards' figure they are slightly expanded.§ The male reproductive organs of *Homarus vulgaris* appear to be intermediate between those of *Paranephrops setosus* and of *Astacus fluviatilis*, for in them the two posterior portions are close together and apparently confluent, though not so perfectly coalescent as in *Astacus*; the vasa deferentia are curiously enough not convoluted, though their extremities are considerably expanded.‖

In accounting for the origin and present distribution of the crayfishes Professor Huxley says:—"Let it be supposed that, at some former period

* Huxley, "On the Classification and Distribution of the Crayfishes." Proceedings of the Zool. Soc., 1878, pt. iv., p. 776.

† Annales des Sciences Naturelles, Sé. VI., ii.

‡ "The Crayfish," p. 130.

§ Hist. Nat. des Crust., Atlas, pl. 12, fig. 14; or the artic e "Crustacea" in Todd's Encyclopædia of Anatomy and Physiology. p. 783.

‖ Milne-Edwards' Hist. Nat. des Crust., Atlas, pl. 12, fig. 15.

of the earth's history, a Crustacean, similar to *Paranephrops* or *Astacopsis* in its general characters, but with the first pair of abdominal appendages fully formed, which we may call provisionally *Protastacus*, inhabited the ocean, and that it had as wide a distribution as *Palæmon* or *Penæus* at the present day. Let us suppose, further, that the northern form of the genus tended towards the assumption of the *Potamobiine*, and the southern towards that of the *Parastacine* type. Under these circumstances it is easy to understand how such rivers as were, or became, accessible in both hemispheres, and were not already too strongly tenanted by formidable competitors, might be peopled respectively by *Potamobiine* or *Parastacine* forms, which, acquiring their special characters in each great river-basin, would bring about the distribution we now witness. As time went on, the *Protastacus* stock might become extinct, or might be represented only by rare deep-water forms, as the *Homaridæ* are represented in the Indian Ocean only by *Nephropsis*."*

The comparison of the male reproductive organs in *Palinurus*, *Paranephrops*, *Homarus*, and *Astacus*, appears to lend every support to this hypothesis, and I have only to add that the *Protastacus* stock appears to have left *Palinurus*, which has lost the chelate limbs possessed by its ancestors, as its marine representative in the Southern Hemisphere.

Though *Paranephrops* is thus in all probability more nearly akin to *Palinurus* than it is to *Astacus*, yet it is curious to notice that in general appearance it resembles *Astacus* much more nearly than it does *Palinurus*. I am not referring to the absence of chelate limbs in *Palinurus*, for they must obviously have been lost after the *Parastacidæ* branched off, but to the size, the colour, the shape of the antennules and antennæ and their size relatively to that of the animal, the narrow thoracic sterna, the movability of the last thoracic segment and the shape of the abdominal appendages. Some of these points, such as the size and colour, are no doubt due to mere adaptation to surrounding circumstances, but it seems difficult to believe that the other resemblances to *Astacus* can be due to the same cause.

My observations with regard to the gastroliths or "crab's eyes" of *Paranephrops* do not agree with those given by Professor Huxley for *Astacus* in "The Crayfish," and I therefore mention it here referring to the body of the paper for the details. He states that the Gastroliths "are found fully developed only in the latter part of the summer season, just before ecdysis sets in," and that they "are cast off with the gastric armature in general." I have, however, obtained specimens in September and October (*i.e.* in the Spring) with gastroliths present. Some caught in September had very small gastroliths, but one caught in October had them

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* Proc. Zool. Soc., 1878, pt. iv., p. 787.

very largely developed; and I have also had two specimens in which ecdysis had evidently taken place some little time before their capture and yet the gastroliths were very largely developed in both. The conclusion I have therefore to draw is that the development of the gastroliths in *Paranephrops* differs from that in *Astacus.*

Paranephrops setosus was first described by Professor Hutton in 1873.*

The various parts mentioned in his description will be more minutely described in their proper places, but there is one small point that needs amending. This is with regard to the hairs on the great claws. These are described as "distant long stiff hairs, the tips of which are often split," but these are in reality small tufts of hairs each containing from six to twelve separate hairs. In each tuft there are two kinds of hairs, one naked and jointed the other plumose and without joints (see under integument). The hairs in each tuft become closely united together in dried or spirit specimens, and thus appear very like single stiff hairs, and this is no doubt the cause of the mistake.

The thoracic sterna in *Paranephrops setosus* are quite narrow, and those corresponding to the first four pairs of ambulatory legs are firmly united together, while that of the last thoracic segment is separate, so that this segment is more or less movable. In this *Paranephrops* resembles *Astacus* and differs from *Palinurus.*

The inferior edge of the pleura of the third abdominal somite is rounded; the anterior portion is slightly more convex than the posterior part and is fringed with several plumose setæ; the posterior portion is almost or quite naked (pl. XXI., fig. 9).

The *rostrum* (pl. XIX., fig. 9) has been already well described by Professor Hutton. The end projects slightly upwards. On the under surface there are two large, median, rather blunt teeth. These teeth and likewise the four teeth on the two sides are subject to some variation, for in one specimen there were four teeth on one side and only three on the other, and in another specimen there was only one tooth underneath.

The *telson* (pl. XX., fig. 4) consists of a single piece, there being no transverse hinge. On each side about one-third of its length from the end there is a strong single spine. The extremity is rounded and fringed with plumose setæ.

Integument.—The integument is completely calcified throughout, excepting such portions as must necessarily remain soft and flexible to allow of the movements of the various parts of the body. The telson and the appendages of the sixth abdominal somite are hard and not semi-membranaceous as in *Palinurus.* The hardest parts are the anterior portion of the

* Ann. and Mag. Nat. Hist., ser. 4, xii., p. 402.

carapace and the great claws. In both of these, but more especially in the latter, the integument is very thick and hard and is beset with many strong sharp spines.

By making sections of parts of the integument it was found to be much the same as that of *Astacus* figured on page 191 of "The Crayfish." It showed the *epiostracum* (pl. XXI., fig. 3 *a*), the *ectostracum* (*b*), and the *endostracum* (*c*), the last being much thicker than the other two together. In the inner part of the *ectostracum* there were numerous rectangular projections extending from the *endostracum* about half-way into the *ectostracum*, but these were very irregular, no two sections being alike as far as these projections were concerned.

Setæ.—There are two kinds of setæ found abundantly on various parts of the body. The first (pl. XXI., fig. 8) consists of a central stem which bears numerous filaments on it, so that it is densely plumose. The stem is all in one piece and is not jointed. In the other kind (pl. XXI., fig. 7) the stem has a kind of joint about the middle. The basal half is quite naked but the terminal half is minutely serrate towards the end, which is usually slightly curved. Both kinds are lodged in a sort of socket in the integument at their base.

The plumose setæ are found on almost all parts of the body, but they are thickest on the telson, the abdominal appendages, the chelæ and the antennæ. The jointed setæ are found chiefly on the chelæ and the antennæ. On the chelæ both kinds are found together forming little clusters each containing about five or six plumose setæ and two or three jointed setæ. Modified forms of these setæ are found in the respiratory organs, in the stomach, and on the antennæ, and are described in their proper places.

Appendages.—The *antennule* (pl. XIX., fig. 1) has the peduncle formed of three joints. The first or basal joint is somewhat longer than the other two together and is broader at its base than at its distal end. On the inner side towards the distal end there is a single, strong, sharp spine. The outer edge is thickly beset with plumose cilia. The aperture of the auditory sac is on the upper side of this basal joint. The next two joints are slightly narrower than the first, but they are much broader in comparison than the two corresponding joints in *Astacus*. Both bear numerous plumose setæ on either side. The third joint supports the two flagella which represent the exopodite and endopodite. The outer one, exopodite (*ex*), is larger and longer than the inner one, endopodite (*en*). In both of the flagella each joint bears some of the two kinds of setæ, the plumose setæ being the more numerous on each joint. In addition to these most of the joints of the endopodite bear a tuft of olfactory filaments (see olfactory organs).

The protopodite of the *antenna* (pl. XIX., fig. 2) is two-jointed. The basal joint is small and bears the conical opening of the green gland (*gg*) and just above it a strong spine. The other joint of the protopodite is large and broad and is divided into two parts more or less movable upon one another. There is a strong spine on the outer side at the base of the scale and another on the inside; and there are three or four other spines on the under surface of the protopodite. The exopodite (*ex*) is represented by the squame or scale, which reaches beyond the basal joints of the endopodite. Its inner edge is curved and fringed with plumose setæ. The base of the endopodite is composed of two joints of about equal size, each of which bears setæ abundantly on the inner side. Each joint of the flagellum bears some of both kinds of setæ.

Mandible (pl. XIX., fig. 3).—The protopodite appears to be essentially the same as in *Astacus*. The palp is 3-jointed but the first two joints are not movable upon one another and the joint between them is somewhat indistinct. The third joint is freely movable upon the second, it is slightly bent near its proximal end, its extremity is rounded and provided with many setæ.

In the *first maxilla* (pl. XIX., fig. 4) the endopodite (*en*) is better developed than in *Astacus*; it consists of a basal joint followed by a short indistinctly segmented flagellum. The basipodite (*bp*) is pear-shaped while the coxopodite (*cxp*) is comparatively small and narrow. Both have their extremities fringed with short styliform setæ.

The *second maxilla* (pl. XIX., fig. 5) closely resembles that of *Astacus* in general appearance, but the scaphognathite (*sg*) is small compared with the rest of the appendage. The endopodite (*en*) is small and undivided. The coxopodite (*cxp*) and basipodite (*bp*) are lamellar and are subdivided by deep fissures into four portions which are much narrower than the corresponding parts in *Astacus*. Their extremities are fringed with setæ.

In the *first maxillipede* (pl. XIX., fig. 6) the coxopodite (*cxp*) and the basipodite (*bp*) are broad thin plates with setose edges; the basipodite is considerably larger than the coxopodite. The endopodite (*en*) is small and consists of a short basal joint and an indistinctly segmented flagellum slightly longer than the basal joint. The basal joint of the exopodite (*ex*) is long and is followed by a flagellum about as long as itself. The epipodite (*ep*) is a soft membranous plate rounded at the extremity and bearing numerous branchial filaments.

Second maxillipede (pl. XIX., fig. 7).—The exopodite (*ex*) is large compared with the rest of the limb; the basal joint is long, thin and fringed with setæ, the flagellum is very well developed, being as long as the basal joint. The coxopodite (*cxp*) is large and broad and bears the podo-

branchia (*pb*) which has no lamella. The anterior arthrobranchia (*ab*) (attached to the membrane uniting the base of the limb to the part of the thorax to which it is articulated), also often comes away with the limb. The basipodite (*bp*) and ischiopodite (*ip*) are both short and of nearly equal length, the latter is broader than long. The meropodite (*mp*) is the longest joint in the endopodite, it is about twice as long as broad. The inner edge of these three last-mentioned joints is abundantly supplied with setæ. The carpopodite (*cp*) is small and narrow. The protopodite (*pp*) is subtriangular, expanding towards the distal end, the dactylopodite (*dp*) is small and rounded. The last two joints are fringed with setæ on both sides.

Third maxillipede (pl. XIX., fig. 8).—In this appendage the exopodite (*ex*) is small compared with the rest of the limb, it reaches to nearly the end of the ischiopodite of the endopodite. It is composed of two parts, the undivided basal joint and the flagellum, the former being slightly the longer. The coxopodite (*cxp*) bears the podobranchia (*pb*) and also the corresponding anterior arthrobranchia (*ab*) ; at the base of the podobranchia is a small tuft of coxopoditic setæ (*cxs*) [see under Respiratory Organs]. The basipodite (*bp*) is indistinctly divided from the ischiopodite (*ip*) which is the longest joint of the endopodite. There are three or four spines on its inner edge, and the outer edge is produced distally into a long sharp spine. The meropodite (*mp*) is little more than half as long as the ischiopodite, on its inner edge are three spines. The carpopodite (*cp*) is narrow at its proximal end, but expands considerably at the distal end, the inner corner of which bears a sharp spine. The propodite (*pp*) is about as long as the ischiopodite, it narrows towards the distal end ; the dactylopodite (*dp*) is narrow, being about three times as long as broad. The inner edges of the basipodite and succeeding joints are fringed with setæ.

The *great claws* each bear a large podobranchia and a small tuft of coxopoditic setæ. The various joints of the limb are abundantly supplied with strong spines arranged as follows :—The ischiopodite has two strong sharp spines on the inside, and two short blunt ones on the outside ; the meropodite has on the inside two rows containing six and four spines respectively, and at the distal end a single spine placed between these two rows, on the outside is a row of four spines, and there are one or two other spines at the distal end ; the carpopodite has three large spines on the inside, one large one on the outside, and smaller ones scattered over the joint ; on the under side of the propodite there are two rows of three and four spines respectively and one spine irregularly placed. On the side on which the movable finger is there are five large spines in a row, and one large one more to the outside, on the other side are two rows extending right up on to the fixed

finger, each row containing about twelve spines. On the outside there is a central row, and also several other spines more or less irregularly placed. On the outer edge the dactylopodite bears two rows of spines, six in one and four in the other, and there are two small spines at the tip. Each finger ends in a strong spine pointing towards each other, and on the inside of the fingers are three or four rounded prominences. There are numerous tufts of setæ on most of the joints, but most abundantly on the propodite.

The *four posterior pairs of ambulatory legs* are somewhat slender; in all except the last the coxopodite bears a podobranchia and a small tuft of coxopoditic setæ.

The *first pair of abdominal appendages* are entirely absent both in the male and female.

The *second, third, fourth and fifth abdominal* appendages are all alike, and are rather simpler than those of *Astacus.* The coxopodite (pl. XX., fig. 1 *cxp*) is very short, and is followed by the long cylindrical basipodite (*bp*) which supports the exopodite (*ex*) and the endopodite (*en*). In the male these are of about equal length, and are imperfectly articulated through their whole length, neither of them having an undivided basal joint as in *Astacus.* Their edges are fringed with long plumose setæ. In a female with the eggs attached under the abdomen the appendages (pl. XX., fig. 2) were found to differ somewhat from those of the male. They were much slenderer and the exoskeleton was much softer; the endopodite (*en*) was considerably longer than the exopodite (*ex*), and in both the articulations were very indistinct; the setæ were long and did not appear to be plumose. In a young female, however, in which the eggs were still in the ovary, the abdominal appendages were much more like those of the male, and were supplied with plumose setæ.

The appendages of the sixth abdominal somite have the coxopodite (pl. XX., fig. 3, *cxp*) broad and indistinctly divided into two or three parts. The exopodite (*ex*) is in the form of a broad oval plate divided into two parts by a transverse hinge, the basal part ends distally in a row of short spines of which the outside one is the longest. The terminal portion is rounded and fringed with plumose setæ. A median ridge runs from the coxopodite through the whole length of the exopodite. The endopodite (*en*) is of similar shape, but consists of one piece only, the median ridge ends in a sharp spine at some distance from the edge.

Respiratory organs.—These differ considerably from those of *Astacus*, and closely resemble those of *Astacopsis.** The epipodite of the first maxillipede is in the form of a broad more or less oval-shaped lamina, the end of which bears numerous branchial filaments similar to the filaments of the

* "The Crayfish," p. 264.

true branchiæ. Hence this epipodite must be looked upon as forming part of the respiratory organs. The next six appendages, viz., the second and third maxillipedes and the first four pairs of ambulatory legs, each bear a podobranchia. These are larger than any of the other branchiæ, but they have no lamina or epipodite corresponding to that of *Astacus*, and many though not all of the branchial filaments have hooked apices (pl. XXI., fig. 5). Each of these six appendages also bears on its interarticular membrane an arthrobranchia. These correspond to the anterior arthrobranchia of Huxley. They are all well developed, but are considerably smaller than the podobranchiæ. To all these appendages except the first, the second maxilla, there is also the corresponding posterior arthrobranchia. These are all of small size, the largest being composed of comparatively few filaments, and they become smaller from before backwards. In fact the last one is almost if not quite rudimentary, though evidently subject to some variation, for, in one specimen, on the left side it was composed of a single short filament, while on the right the filament was longer and bore a short filament branching from it. Four pleurobranchiæ are attached to the epimera of the four hindmost thoracic somites. They are all of moderate size.

These facts may therefore be tabulated thus:—

BRANCHIAL FORMULA OF *Paranephrops setosus.*

Somites and their Appendages.	Podobranchiæ.	Arthrobranchiæ.		Pleurobranchiæ.		
		Anterior	Posterior			
VII.	ep. r.	0	0	0		ep. r.
VIII.	1	1	0	0		2
IX.	1	1	1	0		3
X.	1	1	1	0		3
XI.	1	1	1	1		4
XII.	1	1	1	1		4
XIII.	1	1	1 or r	1		4 or 3 + r
XIV.	0	0	0	1		1
	6 + ep. r. +	6 +	5 or 4 + r	+ 4	=	21 + ep. r., or 20 + r + ep. r.

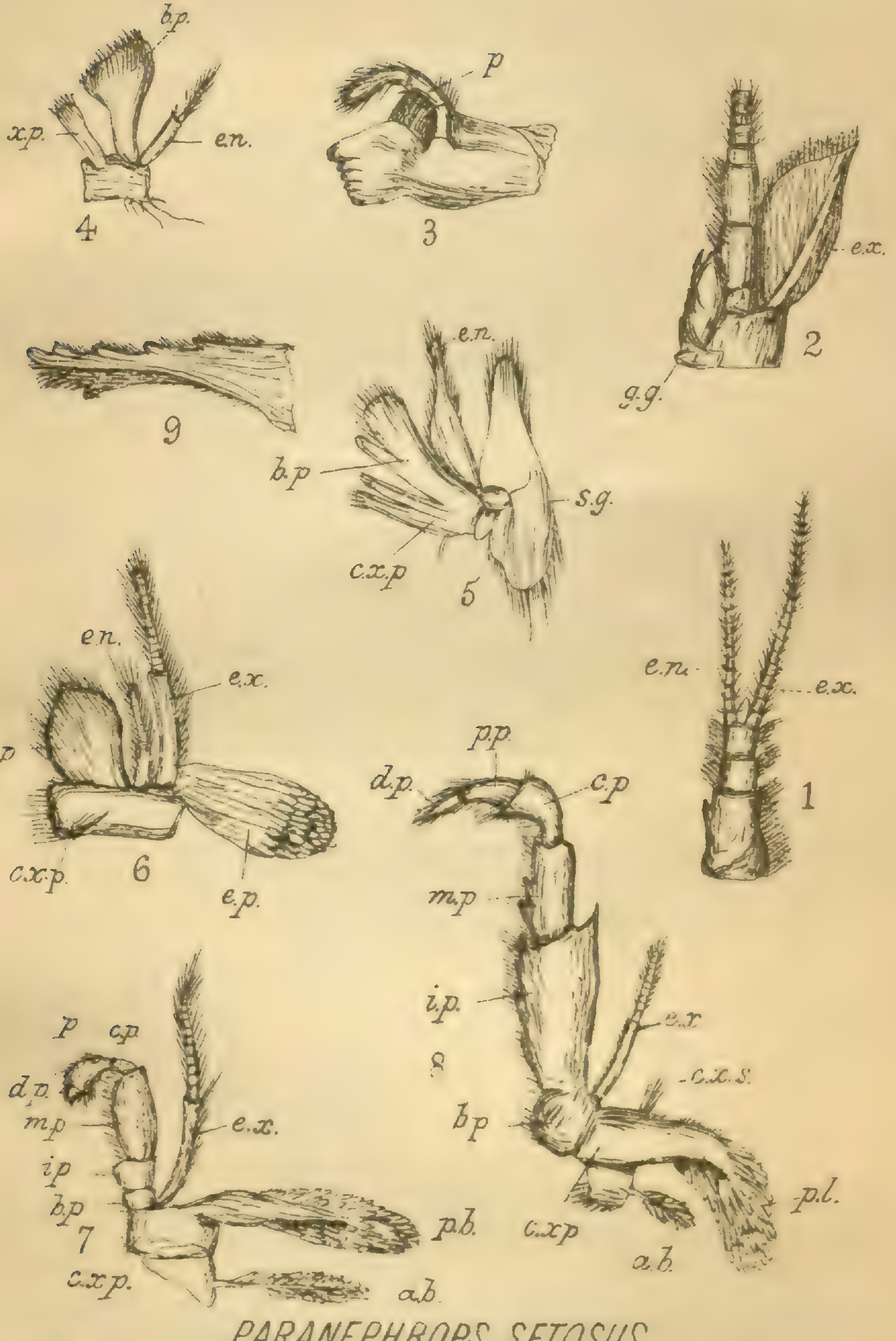
The coxopoditic setæ which are found on the coxopodites of the four pairs of ambulatory limbs, and also of the third pair of maxillipedes, differ considerably from those of *Astacus*. They are few in number and much shorter and straighter than those of *Astacus*. The setæ of which each tuft

is composed appear to be modifications of the naked jointed setæ already described. There is a joint about the middle (pl. XXI., fig. 4 *a*). The basal part is quite naked, the distal half is naked until some little distance past the joint, but is then thickly covered with short simple filaments. These filaments extend nearly to the end of the seta, which is hooked (*b*). In the concave portion of the hook there is often a slight projection (*c*).

The inner surface of each branchiostegite is thickly covered with jointed setæ. In these the filaments on the distal half are less conspicuous than in the coxopoditic setæ; in this point they are intermediate between the coxopoditic setæ and the ordinary jointed setæ found on the chelæ, etc., but they resemble the coxopoditic setæ in having their extremities hooked. On the inferior edge of the branchiostegite there is a row of setæ hanging downwards. These are similar to those found on the inner surface of the branchiostegite except that the extremities are not hooked. I am quite ignorant of the function of all the hooked setæ that I have described; they appear to have something to do with the respiratory organs, as it is only those in immediate connection with the respiratory organs that are hooked.

Circulatory system.—The circulatory system, as far as could be seen without injection, does not appear to differ in any important particular from that of *Astacus*. The heart is of similar shape and lies behind the stomach and above the intestine and reproductive organs. The abdominal artery was readily seen running along the dorsal surface of the abdomen and giving off branches in each somite. The sternal artery was also seen passing vertically downwards to the ventral surface of the animal, where it divides into an anterior and a posterior branch. The arteries arising from the anterior portion of the heart are smaller and are not so readily seen.

Alimentary system.—The general course of the alimentary canal is, as might have been expected, very much like that of *Astacus*. The œsophagus is large in section and expands almost immediately into the capacious stomach. The stomach consists of two parts, the cardiac and the pyloric, the former of which contains a gastric armature, which is fully as complicated as that of *Astacus*. It is formed on the same type, so that the same names can be used in describing the various parts. The anterior edge of the cardiac ossicle (pl. XX., figs. 5 and 6 *c*) is much more convex than in *Astacus*; and the remaining part is divided into four portions, as shown in fig. 5. The urocardiac process (*uc*) is more or less oblong, not quite twice as long as broad, with the sides slightly concave, at the posterior end are two rounded prominences. The median tooth (*mt*) is dense and hard; the end curves forwards and is bifurcated at the summit. The urocardiac process and the median tooth are united by the prepyloric ossicle (*pp*) to the pyloric ossicle (*p*) in the same way as in *Astacus*. The pterocardiac



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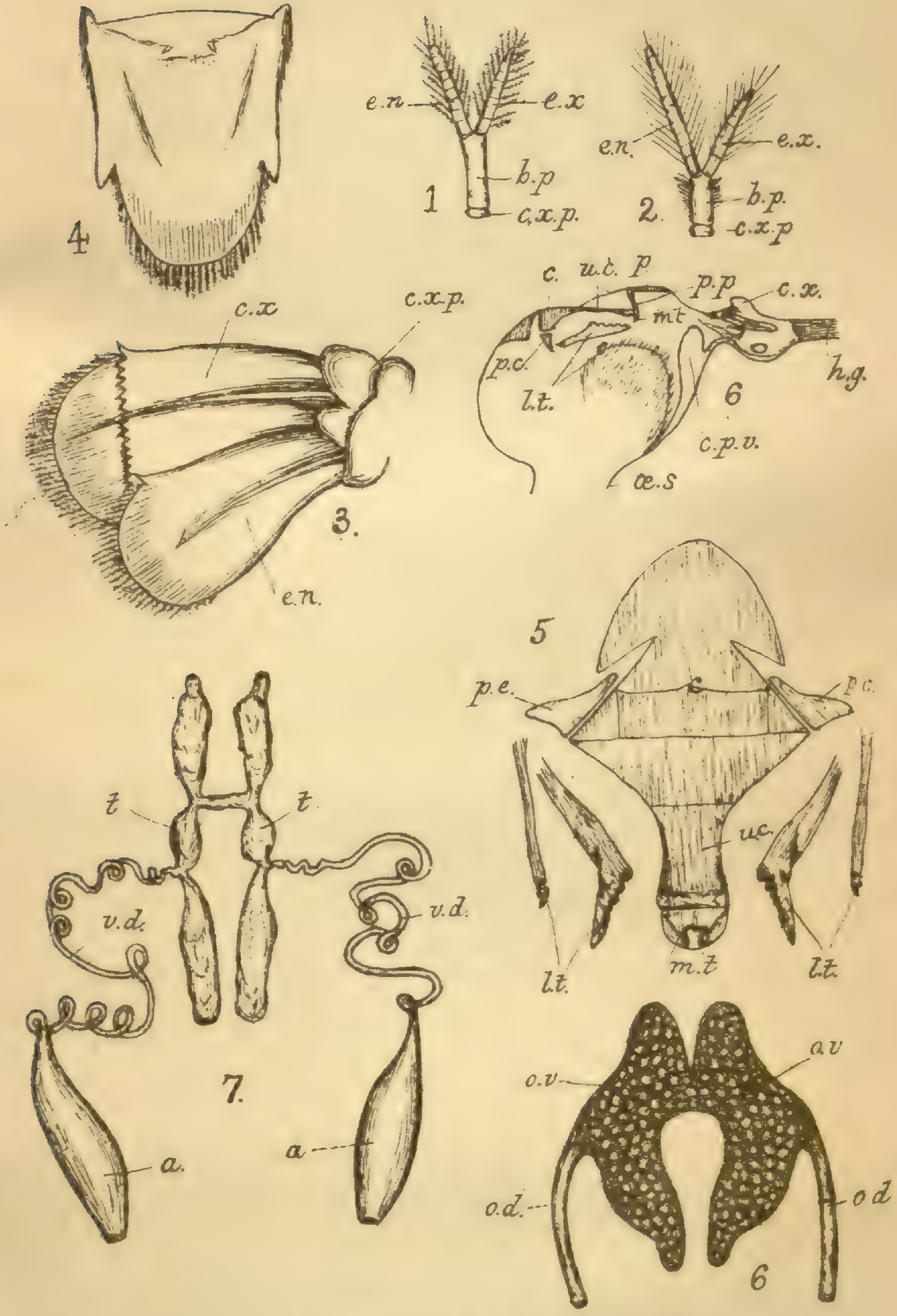

PARANEPHROPS SETOSUS.

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ossicles (*pc*) have much the same shape and position as in *Astacus*. The lateral teeth (*lt*) are large and reddish-yellow in colour. Anteriorly the teeth are large and distinct and there is one large tooth placed on one side of the row; posteriorly the teeth decrease greatly in size, but there are two or three rows so that they form an efficient grinding apparatus. Beneath the lateral teeth on each side there is a small, single, sharp tooth at the end of a long, thin, calcified bar. In a side view of the stomach (fig. 6) this tooth is seen to be also supported by a broad plate, the inner surface of which is thickly covered with short, stiff, plumose setæ. On the raised edge of this plate, projecting from either side into the interior of the stomach, there is a row of setæ similar to the others except in length. These stretch across and meet in the centre and appear to be for the purpose of stopping the food and forcing it to pass through the gastric armature already described. They (pl. XXI., fig. 6) are very long and slender, of the same size throughout almost the whole of their length, often slightly curved towards the end. The stem is unjointed and is covered with filaments, which are not much longer than the diameter of the stem itself.

The pyloric portion of the stomach seems to be essentially the same as in *Astacus*. The cœcum (pl. XX., fig. 6 *cœ*) appears to be variable, for though I have seen it quite distinctly in some specimens, I have been unable after careful search to find it in others. The cardio-pyloric valve (*cpv*) is present as in *Astacus*, and the transverse section of the pyloric region is so very much like that of *Astacus* that I have not given a figure of it.* At the opening of the pyloric sac into the intestine there are valves, one median, one above, and apparently only one on each side.

From the pyloric end of the stomach the intestine passes direct to the anus on the ventral surface of the telson. There is no cœcum in connection with the rectum as there is in the lobster, *Homarus vulgaris*.†

At the sides of the stomach *gastroliths* were found in some specimens. These evidently differ much in shape according to their state of development, and when fully developed they differ considerably from those of *Astacus*. The side turned towards the stomach is either flat or slightly concave. The part which forms the convex side is doubled over so as to join with the flat or concave side, the junction between the two forms a well-marked nearly circular indentation. The flat or concave portion inside this ring is quite smooth. The convex side is more convex than the corresponding part in the gastroliths of *Astacus*, and it also differs in being quite

* See "The Crayfish," p. 53, fig. 9 E.

† See Huxley and Martin's "Practical Biology," p. 133.

smooth while that of *Astacus* being "rough with irregular prominences, is something like brainstone coral." The gastroliths of *Paranephrops* are usually pale blue in colour.

The facts with regard to the occurrence of the gastroliths in the specimens of *Paranephrops setosus* that I have examined are as follows:—First specimen, male, caught October, 1880 (*i.e.* in the Spring), ecdysis had taken place shortly before this animal was caught, for the shed gastric armature was found in the stomach, the exoskeleton, however, was moderately hardened—the gastroliths were very large: second specimen, male, caught about the middle of April, 1881, gastroliths rather small: third specimen, female, caught shortly afterwards, gastroliths absent: fourth specimen, female, caught May, 1881; in this specimen ecdysis had taken place shortly before its capture, the integument was thin and scarcely hardened and the shed gastric armature and membrane were found in the stomach, gastroliths very large: fifth specimen caught later on in May, no gastroliths. Three other specimens were obtained in September, 1881 (*i.e.* early in Spring), of these in two the gastroliths were present though very small, in the third there were no gastroliths. It is therefore evident that the development of the gastroliths in *Paranephrops setosus* must differ from that in *Astacus fluviatilis*.

The *liver* is large and yellow in colour, but it does not appear to differ essentially from that of *Astacus*.

The *green gland* as in *Astacus* consists of two portions, first the gland which is green in colour and communicates with the second part, the sac, which has extremely delicate whitish walls and opens at the base of the antenna (pl. XIX., fig. 2, *gg*). When examined microscopically the gland is seen to contain granular cells, but I did not make out the "much convoluted tube" of Lezdig.*

Nervous system and sense organs.—The main portion of the nervous system, viz., the chain of ganglia on the ventral aspect of the body, appears to closely resemble that of *Astacus*.

Eye.—As in *Astacus* the cornea of the eye is "divided into a great number of minute usually square facets, by faint lines, which cross it from side to side nearly at right-angles with one another."† I have not studied the internal structure of the eye.

The *auditory sacs*, which are situated in the basal joint of the antennules, closely resemble those of *Astacus*, and the auditory hairs from them are exceedingly like the one figured by professor Huxley.‡

* See "The Crayfish," p. 353.

† "The Crayfish," p. 118–9.

‡ "The Crayfish," p. 117, fig. 27, B and C.

Olfactory organs.—These are borne on the exopodite of the antennule. The various joints in the flagellum differ in shape from those of *Astacus*, for the distal end of each is considerably enlarged; this enlargement is chiefly on the under side, for, while the upper edge is nearly straight, the under edge curves so as to form a rounded protuberance towards the distal end (pl. XXI., fig. 1). On these protuberances are situated the tufts of olfactory setæ (*c*), thus there is only one tuft of olfactory setæ on each joint, while in *Astacus* there are two on each joint. Each tuft arises from a slight cavity in the joint and consists of usually five or six olfactory setæ.

The olfactory setæ are similar in shape to those of *Astacus*. Each consists of two parts (pl. XXI., fig. 2), which at first sight appear to be divided by a joint, but on more careful observation it appears that this is not really so, but that the walls of the two parts are continuous, and that the appearance of a joint is caused by the basal part being filled with opaque granular matter while the distal part is clear and transparent. This opaque granular matter extends up the sides further than it does in the middle of the seta.

Reproductive organs.—Male (pl. XX., fig. 7). The testes (*t*) consist of two long tubes united towards their anterior ends by a transverse portion or commissure. The two parts in front of this commissure lie between the heart and the posterior portion of the stomach, and are somewhat directed upwards towards the dorsal surface of the body. Immediately in front of the commissure they become considerably narrower. The portions of the tubes behind the commissures are narrow at first but they soon widen and then soon contract again at the origin of the vasa deferentia. After this they again widen out and at their posterior ends are more closely approximated. Thus a little behind the commissure a considerable space is left between the two tubes, and in this space the heart rests. The vas deferens (*vd*) arises as a very fine tube. The first part differs from the remainder in being smaller and less boldly curved. The remainder is exceedingly convoluted and increases only very slightly in size until it comes to the portion which proceeds directly downwards to the aperture on the bases of the last pair of ambulatory legs. This (*a*) is enormously expanded and is not quite cylindrical, being somewhat laterally compressed. In the figure the convolutions have been separated. I have not been able to observe the spermatozoa, but I have seen in some specimens the other substance which Professor Huxley mentions as filling the vasa deferentia together with the spermatozoa. As in *Astacus* it was of a viscid material and gave "the secretion of the testis the form and consistency of threads of vermicelli."

Female. (Pl. XX., fig. 8.) In the article on "Crustacea," in Todd's Cyclopædia of Anatomy and Physiology, M.-Edwards says that there is a striking analogy between the male and the female reproductive organs in the Crustacea. This is certainly true as far as *Paranephrops setosus* is concerned, for the female reproductive organs are formed on the same plan as the male. They differ very much in appearance, however, for the ovaries (*ov*) are much shorter and thicker than the testes. The two anterior portions are but slightly separated at their anterior ends, and they approach to one another and soon coalesce, so that there is no part which can properly be called a commissure. Behind this they are at first widely separated, so that a hollow is formed in which the heart rests. Posteriorly they rapidly become narrower and approach closer to one another, so that they lie one on each side of the intestine. From about the centre the two oviducts arise and proceed without any convolutions direct to the openings on the basal joints of the second pair of walking legs.

I have not had an opportunity of observing how the young are attached to the mother after birth, but according to Mr. Wood-Mason* they fix themselves to the swimmerets of the mother by the hooked ends of their hinder ambulatory legs, and not by the chelæ as in *Astacus fluviatilis*.

DESCRIPTION OF PLATES XIX.—XXI.

Plate XIX.

In all the figures, *ex*, exopodite; *en*, endopodite; *cxp*, coxopodite; *bp*, basipodite; *ip*, ischiopodite; *mp*, meropodite; *cp*, carpopodite; *pp*, propodite; *dp*, dactylopodite.

Fig. 1. Antennule of left side (× 2).
2. Antenna of left side (× 2); *gg*, opening of green gland.
3. Mandibles of left side (× 2); *p*, palp.
4. First maxilla of left side (× 2).
5. Second maxilla of left side (× 2); *sg*, scaphognathite.
6. First maxillipede of left side (× 2); *ep*, epipodite.
7. Second maxillipede of left side (× 2); *pb*, podobranchia; *ab*, arthrobranchia.
8. Third or external maxillipede of left side (× 2); *cxs*, coxopoditic setæ; *pb*, podobranchia; *ab*, arthrobranchia.
9. Rostrum, side view (× 2).

Plate XX.

Fig. 1. Third abdominal appendages of male (× 2); *cxp*, coxopodite; *bp*, basipodite; *ex*, exopodite; *en*, endopodite.
2. Third abdominal appendages of female (× 2). Letters as in figure 1.
3. The sixth abdominal appendage (× 2); *cxp*, coxopodite; *ex*, exopodite; *en*. endopodite.
4. Telson (× 2).

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* Ann. and Mag. Nat. Hist., 4th series, vol. xviii. (1876), p. 306.

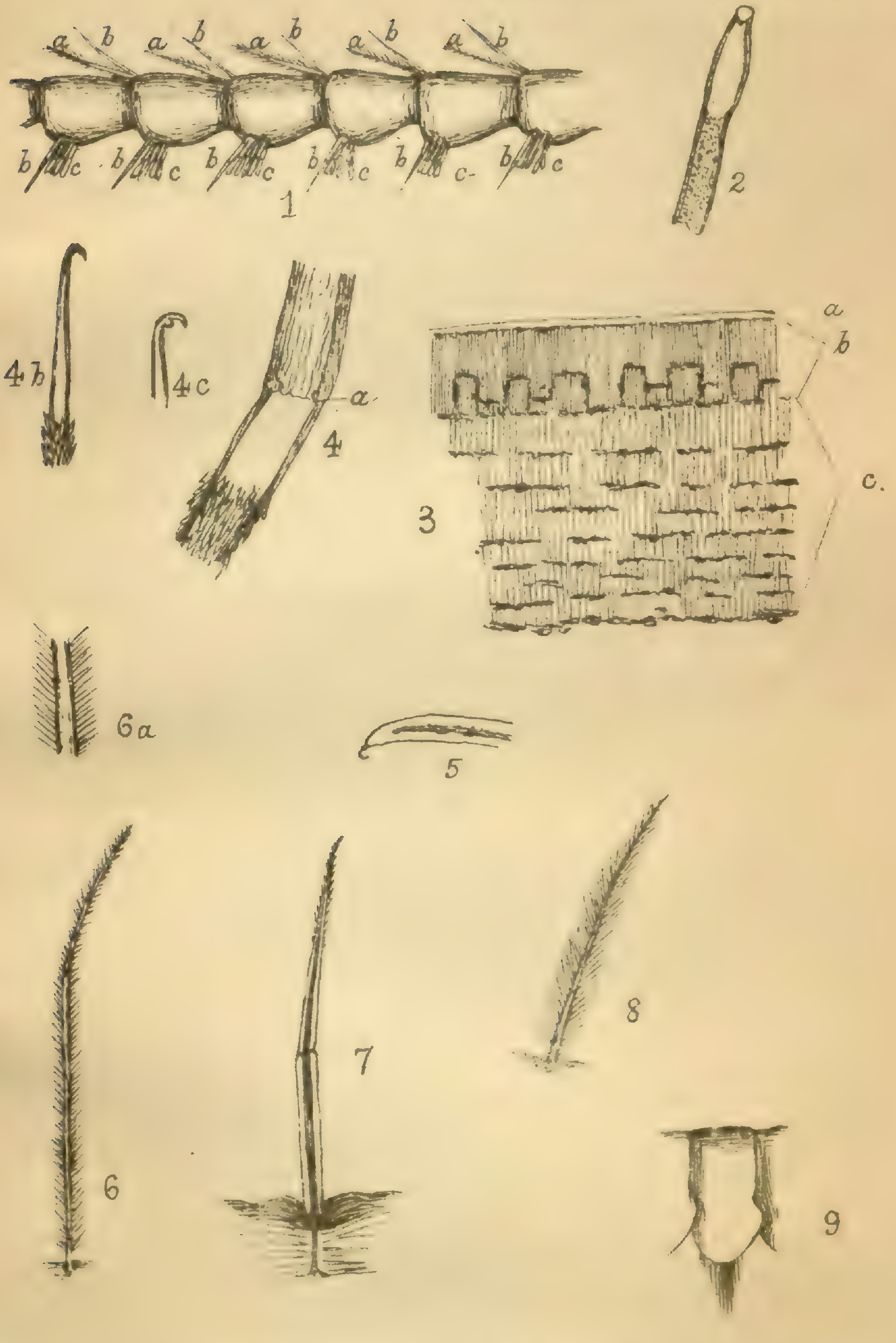

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Fig. 5. View of roof of cardiac portion of the stomach from below, the stomach being laid open by a longitudinal incision along the ventral wall; *c*, cardiac ossicle; *pc*, pterocardiac ossicles; *uc*, urocardiac process; *mt*, median tooth; *lt*, lateral teeth.

6. Longitudinal section of stomach; *œs*, œsophagus; *c*, cardiac ossicle; *pc*, pterocardiac ossicle; *uc*, urocardiac process; *pp*, prepyloric ossicle; *p*, pyloric ossicle; *mt*, median tooth; *lt*, lateral tooth; *cpv*, cardio-pyloric valve; *cæ*, cæcum; *hg*, hindgut.

7. The male reproductive organs (× 2); *t*, testis; *vd*, vas deferens; *a*, expanded extremity of the vas deferens.

8. The female reproductive organs (× 2); *ov*, ovary; *od*, oviduct.

Plate XXI.

Fig. 1. Portion of exopodite of antennule much enlarged, showing—*a*, plumose setæ; *b*, naked setæ; and *c*, olfactory setæ.

2. One of the olfactory setæ (× about 200).

3. Portion of a transverse section of the integument of chela (× about 45); *a*, epiostracum; *b*, ectostracum; *c*, endostracum.

4. One of the coxopoditic setæ (× about 200); *a*, middle joint; *b*, hooked extremity; *c*, another showing peculiar form of the hook.

5. Extremity of a branchial filament from a podobranchia showing the hooked extremity.

6. Seta from the stomach (× about 45); *a*, a portion of the same more highly magnified.

7. Naked seta from forceps (× about 45).

8. Plumose seta from forceps (× about 45).

9. Third abdominal segment, side view.

Art. XII.—*On some newly-discovered New Zealand* Arachnids.

By W. Colenso, F.L.S.

[*Read before the Hawke's Bay Philosophical Institute*, 11*th September*, 1882.]

In bringing before you this evening the few curious and fine *Arachnids*, forming the subject of my present paper (of which I also exhibit specimens), I would first, by way of introduction, call your attention to their systematic position in the great Animal Kingdom. I am the more especially inclined to do this for two reasons:—1. Because of the youthful part of my audience; and, 2. Because these animals (with many of their congeners and allies) are popularly, though erroneously, included under the one general term of Insects. These animals, however, do not belong to the class *Insecta*, but to the allied one of *Arachnida*, which is also a large and varied one, and includes all Spiders, Scorpions, Mites, etc., etc.

My subject and specimen No. 1, will, I think, be found to belong to the family of *Phalangidæ*, or to the next one of *Pseudoscorpionidæ*,—or, what is not unlikely a link connecting both. As far as I know, hitherto only one

species of this last-mentioned family has been detected in New Zealand; and that is a small species of the genus *Chelifer*, (one closely allied to *C. cancroides*) which, I think, I first detected in the neighbourhood of the Bay of Islands, in 1838–1840, and of which early mention was published in 1843.* This animal, however, I now bring before you, making the second found in New Zealand of that or some closely-allied family, is a very different animal from that former one; and although naturally allied to that genus can scarcely belong to it as it is now constituted; and is a very puzzling creature. Indeed I do not know exactly to what known genus to refer it, hence I have provisionally given it the rather peculiar name of *Phalangium* (*Phrynus*) *cheliferoides;* as, under the old Linnæan classification, this animal would be placed in his genus *Phalangium;* but I have good reasons for doubting its being placed there now; the more modern genus *Phrynus* (of all the genera taken out of the Linnæan genus *Phalangium* known to me) seems to be pretty near to it, but of this I am not quite certain from lack of the necessary books of reference.

PHALANGIUM (PHRYNUS) CHELIFEROIDES.

Body 3½ lines long, 2 lines broad, broad-oval, smooth, firm; posterior extremity roundly-obtuse, terminating in a produced point; anterior extremity truncate; *cephalothorax* and *abdomen* in one, no perceptible separation; *shield*, lateral and posterior margins thickened; *abdomen* cylindrical, elevated, thick, slightly marked above and below with five transverse segmental markings; *colour* (general) when fresh, black; after immersion in spirits, dark brown-black.

Eyes, 2, globular, small, prominent on an elevated cylindrical ridge on the top of caput, but nearer to posterior margin of shield, one on each side of the elevation, which is divided in the centre and muricated; *clypeus* broad, studded with minute elevated black points.

Falces very long, first joint 5 lines and second joint 6 lines long, stout, cylindrical, largely chelate, thickly muricated, swollen, clavate or subpyriform for 2 lines towards top; *claws* (chelæ) two-thirds of a line long, arcuated, with a single large tooth in each, superior one overlapping, tips black; *maxillary palpi* 5-jointed 5 lines long, finely hairy throughout, mostly so at the upper part; *colour* pure white, red-pink at the bases and blackish at tips, which are blunt and each bearing a single minute black hook; *mouth* underneath, nearly central, prominent; *maxillæ* semi-circular; *lower lip* notched and both slightly hairy.

Legs, 8, very long, 2½ inches and upwards, cylindrical, and finely filiform, each with a single minute curved black hook at the tip, second pair of legs

* In "Tasmanian Journal of Natural Science," vol. ii., p. 300.

the longest, measuring nearly 3 inches. *Colour* (after keeping in spirits) brown, variegated with many small white spots and rings which under a lens present a subtesselated appearance, those white rings are swollen and appear as if jointed, each bearing two (or more) minute black spines; *coxæ* large, prominent, slightly hairy, hairs patent; *trochanter* very short, smooth; *femur* 7 lines long, beset with short spinous hairs; *tibia* (genual joint) 1 line long, smooth; *metatarsus* of the second pair 6 lines long, (in the other three pairs this joint is only 3 lines long,) with a few short and scattered hairs, and four equidistant white rings; *tarsus* 1 inch and 8 lines long, hairy particularly towards tip, very finely annulated in the upper part and very flexible: this last joint of all the legs is exceedingly fine and flexible and curved at tip; when the animal is taken out of spirits for examination it is very difficult to keep this long last joint steady.

Sternum very small; *anus* produced.

Hab. In dark forests, among long mosses and Hepaticæ on the trunks of living trees 6–8 feet from the ground, "70-mile Bush," between Norsewood and Danneverke, 1879–1881.

This curious and strange animal has greatly puzzled me, not knowing of any genus, or even family, to which it might rightly be referred. In its peculiar and prominent characters it seems to partake of more than one family of *Arachnida*, as they are at present constituted. In its body and long filiform legs it agrees with *Phalangium*, in its long chelate falces with *Pseudoscorpionidæ* (*Cheliferidæ*); it evidently has also some relationship to *Thelyphonidæ* through *Phrynus*, particularly in its extra long and filiform (antennæ-like) second pair of legs; while its large and bent maxillary palpi bear close analogy, if not affinity, with those organs in our endemic genera (of *Orthoptera*) *Deinacrida* and *Hemideina*. There may, however, be some known genus to which it can be hereafter rightly referred; at present I have done my best here (without modern scientific works on *Arachnida*), and by naming it as I have done I have placed it near to its proper place in the Natural System.

Believing this *Arachnid* to be very scarce, and having but *one* perfect specimen, I have not cared to break it up so as to examine it more narrowly, especially as to its buccal apparatus. I have only seen four specimens in the woods, throughout three years, although from my first seeing one in 1879 (which I failed to capture), I have sought most diligently for specimens. In the following year I accidentally, and most unexpectedly, saw another in the same forest, and though I tried long and arduously to secure it without smashing, I failed to do so; it spread out its long flexible legs so prodigiously, that in the end it escaped among the thick vegetation. Its

movements, however, were not fast; but it wore such a strange appearance —black, with its pure white palpi, and its uplifted threatening chelæ, that I, bearing in mind our small blackish *katipo* spider, was on my guard; perhaps too much so.*

In that same year, however, I found, in the evening, among my thick long mosses in my vasculum, one of these *Arachnids*, or rather the anterior half of one without its abdomen, etc.; it was still living and could crawl slowly. Subsequently, in 1881, I secured another and a perfect specimen from among the thick-growing and long *Plagiochila subsimilis* (and then not on the surface, but within!) How the creature can possibly manage to crawl through such fine and dense vegetation is a marvel to me. It generally keeps its long falces upright, or inclining towards its back, and bent at a sharp angle, and sometimes moves them forward alternately in progression, much like a hand or a foot: and sometimes, like its congener *Chelifer* (*supra*), holding them up with distended claws in a threatening attitude.

My second lot belong to the family *Araneidæ* (or True Spiders), and contain three fine species; two of them are, I believe, quite new, and one has been already described in the Trans. N.Z. Inst., but is still little known.

You will, no doubt, remember that at our ordinary meeting held here in August, 1881, I had the pleasure of bringing before you specimens of a fine spider I had then recently received from one of our country members; at that time I promised to lay before you a paper† containing its description, habits, etc., and this I now do.

From that kind country member, Mr. J. Drummond, who resides at Te Ongaonga, I learn (in answer to several letters) that in July, 1881 (our wet season and mid-winter), while engaged in making a drain in some low-lying swampy land, he noticed several large spiders, which were dug up from about twenty inches to two feet under the surface, and though amongst black swampy soft soil, they always came out of the mud quite dry and clean, with their skins looking like velvet.

* Having here alluded to the bite of the *katipo* spider, I should also say (lest I should be misunderstood) that I do not support those monstrous stories respecting the effects of its bite, which some have related; (some of those accounts are, I think, to be found recorded in the early volumes of the Trans. N.Z. Inst.). In past years I had several cases of persons bitten by the *katipo* brought to my notice, including Europeans and Maoris: some of them I had also to attend to medically, and so watched the cases; and while the effects of the bite are generally pretty severe at first, they are transient, being completely over by the second day, leaving no after effects; and never, I believe, caused death, or anything like it.

† See Proceedings, Trans. N.Z. Inst., vol. xiv., p. 566.

The spot seems to have been a remarkably soft one, of a loose spongy muddy nature; for early in the following month (August) he thus writes:—"I found these four spiders, now sent, from one to two feet under ground; but what was black swampy soil last month, is now mud since the heavy rains. This mud seems to boil up through cracks in the upper stratum of clay. I put a bar of iron down sixteen feet, and found soft mud only, and no bottom."

On the 19th of August he again writes: "In further carrying out your wishes I have again been a-spider-hunting, and I give you the result. I found a ronnd hole ¾-in. in diameter in the elevated side of the drain. In carefully cutting into it I first came upon thousands of ants! I never before found so many in one spot. This hole ran nearly horizontally, and was about 6 in. in depth; it was lined throughout with spiders' web, and its bottom was also covered with web; two spiders of small size were in the bottom of this hole. I also found two wings of an insect with the spiders at the bottom; these I also send you with them. The *clay*, etc., on the outside of the entrance to the hole was excavated from within and thrown down. Another similar hole had a blue-gum leaf fastened down with web across its entrance, but there was nothing in it. Another hole, which ran 8–9 inches vertically, had a big spider reposing in the bottom. I could not find any more large spiders, but there are plenty of small ones left. None feigned death on being captured; on the contrary they always ran nimbly away, endeavouring to hide themselves by getting *under* anything. They run very quickly with their legs spread out all round. One of the largest (of those I first sent you) when dug out fell from off the shovel into the drain, and immediately dived under the liquid mud! I plunged the shovel in after it and brought up a shovel-full of mud, and the spider was among it, looking as clean and dry as if it had never been in it, which quite surprised me. Their colours, I find, are much darker after being immersed in the spirits; the yellow stripes are not near so bright as when they were living, and their velvety appearance wholly gone."

Since receiving the foregoing communications, I have had at various times down to the present, several letters from Mr. Drummond, but nothing additional of consequence has been discovered. I much wished to obtain a specimen of a *male*; for, although I have received several specimens, both large and small, they are all females; and I regret to say that I have not yet succeeded. This, however, is no uncommon occurrence among the *Araneidæ*, as it is well known that the males are everywhere fewer in number than the females and consequently much more rarely met with; besides, I believe it is pretty well ascertained, that among the *Territelariæ*, or trap-door spiders, the male is never found within those holes or tubes. And as

there are at least two distinct divisions or families of trap-door spiders inhabiting Europe, (the one with a bung-like or cork-door lid fitted into its nest, and the other with a wafer or flapdoor lid to fall down over its entrance; some of these last-mentioned having also a second door of thick web fitted on a kind of hinge within the tube), I greatly wished to know, if possible, under which division this one should be classed; but down to the present have learned nothing more respecting the lid, or door, though Mr. Drummond has zealously sought after it. Moreover, there is yet another closely-related family (or division) of spiders, living in holes and cracks, which, while they also spin a web within, do not make any door to their nests or holes: these are called *Tubitelariæ.*

The Order of *Araneidæ* (or True Spiders) is an immense one; it is largely represented here in New Zealand, and is daily increasing in books from everywhere. I have noticed in vol. xxx. of the "Linnæan Transactions" (published in 1874), that the Rev. O. P. Cambridge has given a corrected and enlarged list of the number of British spiders alone, containing 78 genera and 457 species, while the number of the foreign ones is legion! This extensive Order has been from time to time subdivided into families and genera, which have been often altered, insomuch that it requires an expert—and a highly-skilled one too—to pronounce certainly on any species. Therefore I have concluded not to attempt to fix on any known genus of *Araneidæ* as being that to which this spider (and another I shall also this evening bring before you) properly belongs, for I have not that special knowledge requisite, neither have we here the modern scientific works on spiders which would assist us in our search. This, however, will not prove to be a very formidable hindrance to our shortly knowing something more definite about these two spiders, for I intend sending specimens by an early mail to England, to the Rev. O. P. Cambridge (one of our greatest modern British araneologists) for his judgment and determination. This gentleman has already described some of our large New Zealand spiders in the Trans. N.Z. Inst.,* and among them is also a trap-door spider from Otago, sent him thence by Professor Hutton and Mr. Gillies; but that species is a different one from our *two* contained in this paper, although it may be not distantly and naturally allied to them. From the disposition of the eyes of these two spiders, I doubt their belonging to the same genus as the trap-door spider from Otago described by him.

No. 1. ——— ———, spider from Te Ongaonga.

DESCRIPTION.

Adult female, length 10 lines, exclusive of falces.

Cephalothorax broad-oval, truncate at each end, posterior extremity much the broader, finely and velvety hairy; upper part of shield smooth;

* Vol. vi., p. 187, and vol. x., p. 281.

thoracic portion rather flat; *head* slightly rounded above, with a few erect black bristles about the eyes; very hairy on lateral edges, and a slight line of hairs running down the indentation and increasing at the base; *colour*, rich umber-brown, with three longitudinal lines of light yellow-brown, one narrow down the back central, and two broader down the sides, all with irregularly crenated margins; lateral edges of shield below the line of a lighter brown.

Eyes, 8, unequal in size, in two rows (their position slightly resembling those of the genus *Philodromus*), 4 anterior in a line in front, and 4 posterior in a curved line above, with the convexity towards face, and the largest at the four corners.

Legs, strong, hairy; *colour* brownish, but lighter than the shield, with scattered black bristles above running somewhat in lines, none below; *metatarsus* and *tarsus* clothed with blackish hairs; relative length of legs 4 1 2 3, the fourth pair 13 lines long; *sternum* small, almost circular or deltoid-cordate, a little broader in front than behind, convex, very hairy, colour dark brown.

Palpi stout and strong, 4½ lines long, very hairy, increasing in hairiness forward; radial and digital joints densely clothed with black hairs; *falces* strong, prominent, black, and shining, with black and brown hairs about their bases; *maxillæ* large, hairy.

Abdomen about equal length with cephalothorax, oval, slightly convex above, and a little higher than cephalothorax; *colour* brown, same as legs but darker, and still darker below; very finely and densely hairy; three longitudinal yellow-brown stripes (in continuation of those on cephalothorax) running half-way towards posterior end and vanishing, and two lines of distant sunken black dots, 3–4 in a line, running downwards.

I think the old females change their colour, losing their light yellow-brown stripes, and becoming nearly wholly brown.

No. 2, —— ——, spider from Napier.

This species I have found here in my garden on several occasions, and always in a similar situation—viz., in a hole in the earth below the surface. In plunging a large flower-pot (of hyacinths, &c., after flowering) into the earth up to its rim, and leaving it there till the following early spring, I am pretty sure of finding one of these spiders in a large hole or burrow underground by the side of the pot. The hole is oval, and as large as a pigeon's egg, about 3–4 inches under the surface, and dark, without any apparent outlet (though such may exist), and devoid of a vestige of web within and without. When taken out and exposed to the light this spider feigns death, and quietly allows itself to be taken up and removed. I have only found them solitary, and (as in the former case) have not yet met with a male.

Description.

Adult female, length 11½ lines, exclusive of falces.

Cephalothorax broad oval, truncate at both ends, posterior extremity much broader; 5½ lines long, and 4 lines wide at the widest part; *thoracic portion* raised, convex, bare of hairs on top; *head* slightly rounded above; *clypeus* very truncate; largely hairy around eyes and face; three slight thoracic segmental markings running down each side; *indentation* sunk, smooth; *colour* rich dark red-brown, with light-brown and greyish coarse hairs, and a narrow light-coloured continuous stripe along the lateral and posterior borders of shield, with the hairs immediately above it of a shade of darker brown.

Eyes, 8, unequal in size, in two rows, (their position, etc., resembling those of the genus *Tegennaria*,) 4 anterior, smaller and equal in size, 4 posterior, the two central ones large, but the two corner ones largest, and more prominent and laterally inclined.

Palpi moderately stout, 4 lines long, hairy, with a single large black spine at end of the radial joint; *falces* prominent, black, shining, and (with *maxillæ*) bearing long shaggy hairs.

Legs medium stout, *colour* rich dark red-brown, hairy with black hairs, increasing in hairiness towards the tips, and having a few scattered black spines, and two black hooks at the tips; *coxæ* very large, smooth and shining in the gibbous parts; *femora* stout and but slightly hairy; two longitudinal rows of strong black spines on *tibia* and *metatarsus* below; the *joints* white, with small black spines; relative length of legs, 4 1 2 3; the fourth pair 14 lines long; *sternum* red-brown, medium size, broad oval, almost flat, slightly hairy, hairs adpressed.

Abdomen, 6 lines long, 4 lines wide, broad oval, hairy, convex above and higher than cephalothorax, the ground of a brownish colour, mottled or irrorated throughout, and very finely dotted with light yellow-brown; two lines of light-brown circular spots equidistant, and five spots in each line, running down towards posterior end; *spiracles* large central, close under base of sternum; *spinners* produced, long.

As I found it impossible to describe wholly and minutely the falces, palpi, and buccal organs of these spiders, without breaking up my specimens and gumming their parts severally down, I forbore to do so, preferring to leave those parts partly undescribed for the time, and so send my perfect and best specimens to England.

No. 3. Macrothele huttonii, *Cambridge*.

This large spider is also from my garden, and is one of those I mentioned as having been described by the Rev. O. P. Cambridge; and I merely bring it before you to exhibit it, and to say a few words respecting its habits and economy; which, I believe, were unknown to its describer.*

* For the full description, and a drawing with dissections of this spider, see Trans. N.Z. Inst., vol vi., p. 200.

This fine spider is by no means uncommon with me; its habitat is often inside an unused and empty inverted earthen flower-pot; if such has been standing in the garden untouched for a year or so, one is pretty certain to be found within it, quietly and snugly ensconced in the midst, or beneath a very large web, spun thickly across the pot in all directions, yet leaving a large and somewhat tortuous passage for the spider; the web itself is of a bluish cast. In the pot are also sure to be found the elytra of pretty large Coleopterous insects, which, no doubt, enter through the hole in the inverted bottom of the flower-pot. Another fine resort for these spiders is under the large wooden cover of my concrete underground water-tank; this cover is scarcely ever removed oftener than once in two years, and there, beneath it, they are to be found, sometimes three or five, but always dwelling apart, in darkness, and concealed in their large extensive bluish webs. This spider also feigns death on its being captured. I have only hitherto detected one male, which, as the Rev. O. P. Cambridge states (and as is generally the case), is smaller than the female.

In one of those specimens of this spider now exhibited (all being females) you will notice that it had formerly lost a leg, which is being supplied by a new (and, at present, a smaller) one. Some of the female specimens of this spider that I have taken, are considerably larger than those described by the Rev. O. P. Cambridge; in all other respects, however, they agree with his scientific description.

ADDENDUM.

A few days after the reading of my paper on some New Zealand *Arachnids* (the same having been noticed in one of our local papers), I received by train a small tin box from a friend in the country, 60 miles distant south, "containing," as he said, "two fine living specimens of my big spider" (*Macrothele huttonii*). On opening the box there was but one of them alive, the other not only being dead but completely dismembered!—every leg torn off at the coxal joint, and the cephalothorax separated from the abdomen. These two spiders were both females, and were of a very large size; the living one was the largest specimen I had ever seen, and was wholly uninjured and very lively. There was nothing put into the little tin box with them, neither moss nor paper. That they would fight and kill, cooped up as they were in such a narrow space, was certain, but that the victor should proceed to such extreme lengths as to tear the conquered one into pieces was new, at least to me. And as this incident seemed an addition to our knowledge of the animal's habits and economy, I have added it.

Art. XIII.—*On the Protective Resemblances of the* Araneidea *in New Zealand.*

By A. T. Urquhart.

[*Read before the Auckland Institute, 26th June,* 1882.]

Although a large amount of valuable work has been done by naturalists in New Zealand, the *Araneidea*, as far as I am aware, have been comparatively neglected; yet it is an order that will repay careful research. The protective resemblances are of considerable interest, and the conformity of tints, which exists between most forms of animal life and their habitations, obtains in the spider fauna. Although more or less conspicuous on webs, when resting beneath boughs, foliage, amongst fragments of rock or loose earth, there is a general similarity of colouration between them and their surroundings, which not only affords them means of concealment, but assistance in entrapping their prey. A large proportion of our spiders are dull-coloured, many possess imitative tints. What the transforming causes are which produce animal colouration cannot be actually determined, as there are apparent difficulties, especially in some individual cases. Owing to the pugnacity of the *Araneidea*, systematic experiments are attended with considerable difficulties.

As most spiders, when it is advantageous to them, habitually select, as their resting-places, leaves, parts of leaves, patches of bark, etc., whose colouring corresponds with their own, there can be no doubt that their protective colouring is largely influenced by the survival—through escaping the observation of their enemies—of those spiders to whom their own particular colouration is most attractive. They appear to possess the instinct, the inherited habit, of discerning resting-places that will render them the least conspicuous; for often the concealment, derived from the spot selected, merely consists of the more or less perfect assimilation of form and colour between the spider and its immediate environment. Some species that may be considered nocturnal—as it would be of no advantage to them—do not possess this habit, but conceal themselves beneath closely-spun webs, in crevices, etc.; their usually black, or dark-grey colouring rendering them inconspicuous when they sally forth at night in search of prey.

The most perfect examples of protective colouring met with in the *Orbitelariæ* have been amongst the *Epeiræ* that frequent dead shrubs—as might have been inferred from their greater need of concealment, owing to the absence of foliage. My attention was more especially drawn to them in 1874, when I carefully searched through upwards of forty acres of manuka (*Leptospermum*)—burnt two years previously. I found, with very few exceptions, that their colours corresponded with the charred shrubs; being of various shades, ashy-grey, marked with black. Some spiders are a pale ash-

grey and black, and when crouching in the ascil of a bleached branch, it takes close observation to detect them, there being, in some instances, not only no perceptible difference in the shades of colour, but owing to the peculiar mottling and little irregular limbs on the abdomen, the rugose bark itself is closely imitated.

The generality of spiders found amongst burnt manuka, before it has become bleached, have the brownish-black colour of their environment, which causes them to be almost imperceptible at a very short distance.

On green manuka a greater variety of spiders are to be seen; the majority are of various shades of grey or brownish-grey, the legs marked with reddish-brown; green are occasionally met with; brown or greenish-brown spiders are not uncommon; variously marked with white, buff, purple, yellow, or reddish tints; colours which are all reproduced in the bark, young wood, fading leaves, and lichens. I recently met with a spider of special interest; it had an unusual purple tinge, and was covered with soft white hairs, which made it closely resemble the silky purple shoots of the *Leptospermum* on which I found it. Occasionally a spider of considerable interest will be met with amongst the capsules of the *Leptospermum*—which is a favourite resort—the abdomen has a rough uneven surface; the furrows formed by the peculiar arrangement of the impressed spots give it the appearance of being valvate; a dark grey penetrative tint appears beneath the outer and lighter one, which causes the abdomen to resemble a bloom-covered capsule. Although the spider only possesses four not very clearly-defined pseudo-valves, the deception is still very striking, and affords an interesting example how some of the wonderful cases of protective resemblance or mimicry may have arisen.

On the *Cordyline australis* small spiders are to be met with which not only assume the colour of the trunk, but, owing to their flat sometimes angular figures, and largely-developed tubercles, imitate the muricate bark. These spiders are difficult to detect when resting in the interstices of the bark.

If quite different plants are examined—rushes, for example—they will also be found to be frequented by specially-adapted forms; the most numerous is a species (*Theraphosides*) with a narrow cylindrical brownish-yellow abdomen, and long slender legs, which it extends in a manner that renders it hardly perceptible.

Many of our geometrical spiders frequent the furze (*Ulex europæus*), where they mostly take the tints of the decaying vegetation—which, owing to their habit of concealing themselves amongst the fading leaves and flowers, must be advantageous to them. The light brownish-yellow and

greenish-yellow resemble the faded leaves and puberulent sepals; the dark grey—especially when covered with whitish hairs—are not unlike the pods. Of the few brightly-coloured spiders we possess that may be considered to have protective colouring, one is to be met with amongst the leaf-spines and yellow blossoms, which harmonize well with its bright dark-green body and yellow and white tubercles; the latter might pass off for small flower-buds. Little greenish-buff or light stone-coloured spiders, with pointed abdomens, will sometimes be mistaken for the buds, owing to their habit of crouching in the ascils of the leaf-spines.

Hedges of kangaroo acacia (*Acacia armata*) are inhabited by reddish-brown or greenish-brown spiders, according to the prevailing tints of the wood.

This autumn I found on the fading petals of a yellow dahlia a rather large dark-brown and orange-yellow spider, possessing such perfect assimilative hues, that by an untrained eye it was mistaken for a part of the blossom. This, however, is not an exceptional case, so accurately do the tints blend, and so adapted are their attitudes to their particular haunts that spiders are often undistinguishable at a few feet distance.

On fruit trees interesting forms are occasionally met with, although spiders are comparatively scarce, except in the winter and spring months, when they are inhabited by numerous young *Epeirides*, which are worthy of attention, for although many of them are very minute, the faculty of discerning the tints that correspond with their own seems fully developed. The little reddish spiders are, as a rule, on red-barked trees; the browns and greys in branches with similar hues. They also derive protection from the special form and colouring of the figure on the abdomen; the dull white spot on some of the smaller spiders is not unlike a scale insect; the heart-shaped pattern on the larger spiders is by no means a bad imitation of a bud covered with greyish tomentum. Crouched on the diseased boughs of pear trees small spiders will sometimes be found possessing the colouring of the blighted bark and lichens. Amongst other naturalized plants, interesting examples are to be found on the *Coniferæ* and *Eucalypti*.

The beautiful little quasi-parasitic spiders found on the webs of the large *Epeirids*, owing to their silvery hemispherical abdomens and habit of suspending themselves by their slender legs, may possibly derive some protection through being mistaken for dew-drops. They fall to the ground when threatened.

The majority of terrestrial spiders are earth-coloured and other dull tints; many of them have one or more bands of a different shade or colour, which, no doubt, from their habit of hunting amongst herbage and exfoliate bark, yield them the same protection as similar stripes do many of the

higher forms of life. The numerous *Lycosidæ* are mostly of sombre colours, well adapted to their habits and haunts. Amongst the jumping spiders (*Salticides*) the colouring ranges from earthy tints to a whitish-yellow. The brighter tints, if seen in captivity, would be pronounced conspicuous; but in their natural haunts their straw-coloured oblong-oviform figures match so well the dried clumps and leaves of grass, etc., that it taxes the collector's eyesight to follow them as they jump and run through the low vegetation. One small earth-coloured species affects loose earth, where it is not easily observed unless carefully searched for; another species, living apparently in small communities, inhabits dry banks: it is a light brown. Of one species (*Thomisides*) that hunts amongst the leaves of low plants, the cephalothorax is brown, the cylindrical abdomen pea-green, resembling a bud. The *Drassidæ* that live under decayed *débris*, water-ditches, etc., have earthy and other dull tints. In giving these examples of dull colouring, I do not mean to assert that they are entirely due to protective influences. There is one point of interest in regard to protective colouring, especially dull tints, that is, the comparative powers between our own vision and that of the spiders' enemies—especially birds—for many of the so-called dull tints of our unaided vision are by no means so under a lens of low power.

The assimilation of hues between spiders and their environment is often increased by the specific pattern, formed by dashes of colour which match the brighter tints of the vegetation they frequent. It is not unusual to find the tubercles apparently overgrown with minute lichens. The pattern on the abdomen sometimes has the form and colour of a lichen (*Parmelia*); which tends to give the abdomen, when seen in a favourable position, the appearance of a lichen-grown knot. Very good specimens are to be found under tufts of *Usnea* on old fences or trees. The most wonderful example of protective resemblance that I have met with, was a light-brown spider,—abdomen 10 mm. long,—the specific pattern, glaucous-white, 8 mm. long, took the perfect form of a lobulate thallus, which was only attached to the abdomen by its base, close to the pedicle. For nine years I have searched in vain for a similar specimen; no spider was ever met with which had the pattern detached to any extent from the integument.

It may be of interest to mention that, when black forms distinctive marks on the abdomen, it always has the form of patches, bands, or little irregular lines which pick out the lighter tints, causing the integument often to resemble rugose bark,—it never (?) imitates foliaceous lichens; such mottling is composed of lichen colours—*i.e.*, the prevailing tints of the foliaceous lichens growing about the haunts of the spider.

The special adaptation of form and colouring to the particular conditions of life, is a matter of great interest; and the more animal-colouration is

studied, the more evident it becomes that it is not what it was once thought to be, but that it is determined by various causes, the most potent of which is undoubtedly need of protection.

It may be as well to bear in mind that, although these few notes have the pretentious title "in New Zealand," they only refer to my own district.

Art. XIV.—*Remarks upon the Distribution within the New Zealand Zoological Sub-region of the Birds of the Orders* Accipitres, Passeres, Scansores, Columbæ, Gallinæ, Struthiones, *and* Grallæ. By W. T. L. Travers, F.L.S.

[*Read before the Wellington Philosophical Society, 21st October*, 1882.]

A very cursory examination of the avi-fauna of New Zealand is sufficient to show that it presents some of the features especially characteristic of all forms of life in oceanic islands, namely,—that an order is often represented by one or two families only;—that the number of families is large in proportion to the number of forms;—and that, in the great majority of cases, the genus is represented by one or, at most, two species.

This feature is naturally most observable in the cases of the land birds and waders, to which alone I purpose calling attention in this paper.

In preparing the annexed tables (compiled from Dr. Buller's recently-published handbook, with certain corrections which I have found it necessary to make) I have adopted the limits assigned by Mr. Wallace, in his work on the geographical distribution of animals, to what he terms the New Zealand zoological sub-region, but I purpose to deal very shortly with the case of its more remote outlying districts, inasmuch as the few birds common to them and to the main islands are all of sufficiently powerful flight to account for their occurrence at points far apart.

Since the publication of Mr. Wallace's work, the investigations of the "Challenger" scientific expedition have shown that a very great gulf lies between New Zealand and Australia, a gulf so great, indeed, as to lead irresistibly to the conclusion, that whatever may have been the former extension to the eastward of the lands of which the main islands of New Zealand and the Chatham and Auckland groups are the remnants, no land connection has existed between New Zealand and the Australasian Continent within, at all events, the Tertiary period. Strange, therefore, as it may appear, we can only account for the presence in New Zealand of existing Australian birds by assuming that they must have winged their way hither across the intervening 1,200 miles of ocean. This feat is quite within the powers of flight of the majority of the birds which are common to both

habitats, and of such occasional visitants as *Hirundo nigricans*, *Eurystomus pacificus*, *Platelia regia*, and others, but certainly appears to be a heavy task for *Nycticorax caledoniensis* and *Zosterops lateralis*. Mr. Wallace himself, however, calls attention (in the work above referred to) to the fact, that small and weak birds are often carried accidentally across great widths of ocean by violent gales, and instances the case of the large number of North American birds which are from time to time found on the coasts of Europe during the prevalence of westerly winds. The occurrence in New Zealand, of forms common to it and Australia is, therefore, explicable without resorting to any supposition of a former land connection; and the discovery in New Zealand, within the few years which have elapsed since the colonization of the islands, of no less than eight instances of occasional visitants from Australia and Tasmania, gives strength to the supposition that they were aided in their transit by strong north-westerly winds. In this connection I may mention that the common sparrow has recently found its way to the Chatham Islands without man's intervention, no doubt assisted across the intervening waters by a north-west gale, and although both Mr. Wallace and Dr. Buller treat *Zosterops lateralis* as a true New Zealand form, I think it pretty certain that we owe its presence here and in the Chathams to a similar cause. The enormous increase in the numbers of this bird which has taken place both in Australia and New Zealand, is evidently due to a corresponding increase in the quantity of suitable food provided by the introduction, into both countries, of various kinds of succulent fruits, and of a great variety of foreign insects. The Maoris, who now capture the *Zosterops* in thousands for potting-down, and who are very shrewd and intelligent observers, unhesitatingly assert that it is a stranger and of comparatively recent appearance in these islands.

Mr. Wallace is in error, moreover, in supposing that the *Zosterops* found in the Chathams differs from the form which occurs in the main islands.

Reverting now to the principal objects of these notes, I find from the Hand-book that the seven orders which I am dealing with comprise (exclusive of occasional visitants from Australia) 19 families, 47 genera, and 88 species, the occasional visitants from Australia and Tasmania numbering 8 species belonging to 6 families and 7 genera.

Of the 47 genera, 25 have only one species each, 10 have two species, 7 have three species, 3 have four species, and 2 have five species.

Of the 88 species (excluding, as above-mentioned, the occasional visitants) 66 are peculiar to the main islands the Chathams and the Aucklands together, 18 are common and peculiar to both the main islands, 8 are common and peculiar to the main islands and the Chathams, 3 are common and peculiar to the main islands and the Aucklands, 22 are common

to the main islands and habitats outside of them and of the Chatham and Auckland Islands, 9 are peculiar to the North Island, 16 to the South Island, 6 to the Chathams, 2 to the Aucklands, 1 is common and peculiar to the North Island and the Chathams, 2 are common and peculiar to the South Island and the Chathams, and 1 is common and peculiar to the main islands and the Chatham and Auckland Islands. In making this analysis I have assumed that Dr. Buller has seen good reasons for reaffirming *Platycercus alpinus* as a species, notwithstanding the remarks on the subject in his larger work, and that there is also good ground for including the bird called called *Platycercus rowleyi* as a species; it seems, too, that Dr. Buller does not accept Finsch's views in relation to *Apteryx australis* and *Apteryx mantelli*. Assuming these points, and looking, in the first place, at the species peculiar and common to both the main islands only on the one hand, and those peculiar to the North Island on the other, it will be seen that there is only one instance in which any genus represented amongst the latter is represented by species amongst the former, namely, in the case of *Apteryx*, there being only one species, out of the four belonging to that family, which is common to both islands, namely *Apteryx oweni*, unless we accept Dr. Finsch's views that *Apteryx mantelli* is only a variety of *Apteryx australis;* and then, looking at those species which are peculiar and common to both the main islands only on the one hand, and those peculiar to the South Island on the other, it will be seen that there are four instances in which a genus represented amongst the latter is represented by species amongst the former, namely, in the cases of *Zenicus*, *Sphenœacus*, *Nestor*, and *Apteryx*.

Of the species peculiar to the North Island there are seven, namely *Orthonyx albicilla*, *Petroica toitoi*, *Petroica longipes*, *Turnagra hectori*, *Glaucopis wilsoni*, *Apteryx mantelli* and *Ocydromus earli*, which have representative species in the South Island, namely, *Orthonyx ochrocephala*, *Petroica albifrons*, *Turnagra crassirostris*, *Glaucopis cinerea*, *Apteryx australis*, *Apteryx haastii*, and *Ocydromus australis*, *fuscus* and *brachypterus*, whilst the remaining two of those which are peculiar to the North Island, namely *Pogonornis cincta*, and *Heteralocha acutirostris*, although each belongs to a family of which there are genera in each island, have no special representatives in the South Island. In like manner two of the species peculiar to the South Island, namely *Certhiparus novæ-zealandiæ* and *Notornis mantelli*, although each belongs to a family of which there are genera in both islands, have no special representatives in the North Island, whilst the genus *Notornis* is represented by *Notornis alba* in Norfolk Island, one of the most distant of the outlying districts assigned to the New Zealand zoological sub-region.

I have already mentioned that the North Island possesses nine species peculiar to itself, of which *Orthonyx albicilla* is represented in the South Island by *Orthonyx ochrocephala.* The latter is a very different-looking and somewhat more robust bird than its North Island congener, but notwithstanding this difference in size and the greater differences which the two forms present in external characters, they both have precisely the same habits and notes. The differences between the external characters of the species of *Petroica*, *Turdidæ*, *Apterygidæ*, and *Ocydromus* peculiar to each of the main islands, though less manifest than in the case of the two species of *Orthonyx*, is very well marked, but in each of these instances also the habits and notes of the birds are the same. In the case of the *Corvidæ*, the North Island species is only distinguished from the South Island one by its slightly larger size and by the colour of the wattles, but in this instance also the notes and habits of the birds are identical. It will have been observed by those who have seen them in their natural state, that, with the possible exception of *Pogonornis cincta*, all the birds of flight peculiar to the North Island, and with the exception of the two species of *Nestor*, all those peculiar to the South Island, which frequent forest habitats in the respective islands, are birds which never voluntarily rise above the level or move outside the limits of the forests in which they dwell, and the chances are, therefore, very remote that any of them should pass, in numbers at all events, across the waters dividing the two islands.

The same observations may be applied to a large proportion of the species common and peculiar to the two islands, rendering it remarkakle that so many of them should have retained common characters during the enormous period that must have elapsed since the formation of Cook Straits.

The non-occurrence of *Heteralocha acutirostris* in the South Island may excite surprise ; but it must be remembered, in the first place, that this is one of the birds which never voluntarily rises above the level or passes outside of the limits of the forest in which it lives, and in the next, that its range, even in the North Island, is restricted to mountain districts so placed that the only winds of sufficient strength to overcome the efforts of stray birds to return to their own special abode, would prevent their crossing the dividing waters. The restriction in the range of this bird is, however, not so surprising as that which occurs in the cases of *Nestor occidentalis* and *Nestor notabilis* in the South Island, seeing that, apparently, the very same natural conditions as those which characterize their respective special habitats, extend over a large portion of both islands. We are but little aware of the circumstances which operate in causing a restriction in the range of any particular species, or which may lead to the local

extinction of some particular form, and until we have before us well-considered observations on both these subjects, we must remain unable to account for such cases as those last above referred to.

A very remarkable instance of rapid and apparently unaccountable extinction is presented to us in the North Island, in the case of *Anthornis melanura*. For years after this colony had been settled this bird was common all over both islands; but it seems to have disappeared from the North Island, although at present it is not merely abundant but actually increasing in numbers on the other side of the Straits. The rat and the bee may each have played a part in bringing about its disappearance from the North Island, as both of these swarm all through the forest there, whilst in the South Island the rat has been nearly extirpated from the great *Fagus* forests by the woodhen (*Ocydromus*), and the bee is limited in its range to the cultivated districts. But the cause of the disappearance of this bird is mere matter of speculation, and I have only cited the case in order to show how little we really know of the circumstances which may govern or limit the distribution of any particular species.

I do not know upon what authority Dr. Buller (in his Manual) has given the Chatham Islands as a habitat of *Stringops habroptilus*. I find no mention of this in his larger work. He probably follows Mr. Wallace in making the statement, but without giving the reasons assigned for it by that writer. Mr. Wallace says (speaking of the Chatham Islands) "that the Natives —I presume the Morioris—declare that both the *Stringops* and *Apteryx* once inhabited the islands, but were exterminated about the year 1835." In the first place, so far as I have been able to ascertain, the Morioris had no knowledge whatever of either *Stringops* or *Apteryx*. In the next place, the date fixed for their extirpation is singular. It was in that year that a numerous war-party of the Ngatitama (one of the most savage and ruthless of the New Zealand tribes) chartered a whaleship to take them to the Chathams, the existence of that group and its occupation by a peaceful and well-fed people having been reported to them by a member of their tribe, who was serving as a sailor in an European vessel which had then recently come into Wellington Harbour after visiting that group.

The Ngatitama invaded the islands for the sole purpose of slaughter and cannibalism, and, in the course of a very few months, had nearly "extirpated" the unfortunate Morioris, one of the leading chiefs of the invaders (whose *taiaha*, made from the bone of a whale, is in the Wellington Museum) actually living for many months almost exclusively upon the flesh of young children. Until the statement above referred to had appeared in Mr. Wallace's work, my son, who was the first to collect systematically the fauna and flora of the Chatham Islands, and who spent upwards of a year

there for that purpose, and who was diligent in his enquiries, had never heard it even suggested that either *Stringops* or *Apteryx* had existed there. He was informed that a bird described as resembling a New Zealand *Ocydromus* was formerly found abundantly on the main island of the group, but he believes that the bird referred to was *Rallus dieffenbachii*, of which Dr. Buller tells us that the last recorded specimen was obtained by Dr. Dieffenbach in 1842. At all events I am not disposed to accept statements as to the occurrence either of *Stringops* or *Apteryx* in this habitat until something more satisfactory than the alleged "declaration of the Natives" is brought forward in support of it.

It has been suggested that specimens of *Stringops* and of some South Island species of *Apteryx* may have been taken to the Chathams by Maori voyagers, which I do not however believe, and therefore, whilst the occurrence of a form of *Ocydromus* upon this group would not have been very surprising, that of *Stringops* and *Apteryx* would, if for no other reasons than, firstly, that no part of the islands presents physical conditions at all similar to those which obtain in the known habitats of those birds; and, secondly, that had these birds ever existed there at all, they would certainly have been extirpated by the Morioris long before the latter were themselves practically extirpated by the Ngatitama. Assuming, however, that the Chatham Island habitat may be eliminated from the question, the continued existence in both the main islands of New Zealand of such forms as *Stringops habroptilus* and *Apteryx oweni* is a most noteworthy and extraordinary fact. It will be observed that all the other birds mentioned in the tables, as well those common and peculiar to both the main islands as those common to them and to other habitats, possess powers of flight which prevent any suggestion of impossibility in accounting for their distribution, and that in the cases in which particular species in one of the main islands are represented by species in the other, the ordinary laws of variation may be sufficient to account for the observed differences. But the persistency of such types as *Stringops* and *Apteryx oweni* stands upon a different basis, unless we resort to the suggestion that each of these species may have been introduced by Maori voyagers from the South to the North Island within comparatively recent times, it being noteworthy that both are used as call-birds and pets by the native inhabitants of the South Island districts in which they are found.

Setting aside the supposed occurrence of *Stringops*, *Apteryx*, and *Ocydromus* in the Chathams, we have certain facts in connection with the species peculiar to that group, which add considerable strength to the conclusion derived from an examination of its flora, namely, that it was formerly directly connected by land with the main islands of New Zealand. In the

first place, five of the six peculiar species have representatives in both the main islands of New Zealand, but are themselves specifically distinct from any of the latter, the *Anthornis* and *Rallus* especially presenting marked differences from the New Zealand forms. Except in these more extreme instances, the variations in the other species are very similar in extent to those which are presented by their respective special representatives in the main islands.

It will be observed too that, except in the case of *Anthornis*, all the above instances are those of birds of weak flight and of close habits. The case of *Cabalus modestus* is one of peculiar preservation, analogous to that of *Notornis* in the South Island.

The Auckland Island birds call for less remark, the only species peculiar to that group which has any general representative in New Zealand being *Rallus brachipus*, whilst the four species common to both habitats are all birds of strong flight.

Of the birds common to the New Zealand zoological sub-region and habitats outside of it, the only instances which present any peculiarity are *Ortygometra tabuensis* and *Porphyrio melanotus*. The former is a peculiarly close bird in its habits, and seldom takes wing when pursued, but its powers of flight are considerable when put in use. The latter is a heavy and laboured flier, and although we may not marvel at its presence in both the main islands and even in the Chathams, it is not easy to account for the persistency of a species so widely distributed and so unlikely to undertake a migration from one zoological district to another, more especially if the distance between them be great.

I do not pretend to account for the differences observable between the species common and peculiar to the main islands and the allied species peculiar to each, or, indeed, for any other of the phenomena above referred to; the full materials for such a purpose having yet to be collected.

It will be seen that many of the instances to which I have called attention bear a strong analogy to the cases observed by the late Mr. Charles Darwin in the Gallipagos Islands, and that we have in relation both to that and to our own group, a problem of no ordinary difficulty to solve. Its solution may not be beyond our reach, but can certainly only be arrived at by patient and exhaustive observations.

The tables appended to these notes will probably be found to be useful addenda to the recently published manual.

Table I.

Showing the Families, Genera, and Species of New Zealand Birds belonging to the Orders Accipitres, Passeres, Scansores, Columbæ, Gallinæ, Struthiones, and Grallæ:—

Order.	Family.	Genera.	Number of Species.
1. Accipitres	1. Falconidæ	1. Hieracidea	3
	2. Strigidæ	2. Athene	2
2. Passeres	3. Alcedinidæ	3. Halcyon	1
	4. Meliphagidæ	4. Pogonornis	1
		5. Prosthemadera	1
		6. Anthornis	2
		7. Zosterops	1
	5. Certhiadæ	8. Zenicus	2
		9. Acanthisitta	1
		10. Orthonyx	2
	6. Luscinidæ	11. Sphenœacus	3
		12. Gerygone	3
		13. Certhiparus	1
		14. Petroica	5
		15. Anthus	1
	7. Turdidæ	16. Turnagra	2
	8. Muscicapidæ	17. Rhipidura	2
	9. Corvidæ	18. Glaucopis	2
	10. Sturnidæ	19. Aplonis	1
		20. Creadion	1
		21. Heteralocha	1
3. Scansores	11. Psittacidæ	22. Stringops	1
		23. Platycercus	4
		24. Nestor	3
	12. Cuculidæ	25. Eudynamis	1
		26. Chrysococcyx	1
4. Columbæ	13. Columbidæ	27. Carpophaga	1
5. Gallinæ	14. Tetraonidæ	28. Coturnix	1
6. Struthiones	15. Apteryx	29. Apteryx	4
7. Grallæ	16. Charadriadæ	30. Charadrius	3
		31. Thinornis	1
		32. Anarhynchus	1
		33. Strepsilas	1
		34. Hæmatopus	2
	17. Ardeidæ	35. Ardea	5
	18. Scolopacidæ	36. Limnocinclus	1
		37. Limosa	1
		38. Recurvirostra	1
		39. Himantopus	3
		40. Tringa	1
		41. Gallinago	2
	19. Rallidæ	42. Ocydromus	4
		43. Cabalus	1
		44. Rallus	3
		45. Ortygometra	2
		46. Notornis	1
		47. Porphyrio	1

Table II.

Showing the number of species as distributed in each of the several habitats given below, including occasional visitants from Australia and Tasmania:—

No.	Habitat.	Number of Species.
1.	Both Islands only	18
2.	Both Islands and Chathams only	8
3.	Both Islands and Aucklands only	3
4.	Both Islands, Chathams, and Aucklands only	1
5.	Both Islands and habitats outside of them, and of the Chatham and Auckland Islands	22
6.	North Island only	9
7.	South Island only	16
8.	Chathams only	6
9.	Aucklands only	2
10.	North Island and Chathams only	1
11.	South Island and Chathams only	2
	Total species	88

Table III.

Showing the names of the species in each of the several habitats mentioned in Table II.

Both Islands only.

1. Athene albifacies.
2. Zenicus longipes.
3. Acanthisitta chloris.
4. Sphenœacus punctatus.
5. Gerygone flaviventris.
6. Gerygone sylvestris.
7. Creadion carunculatus.
8. Stringops habroptilus.
9. Platycercus alpinus.
10. Platycercus rowleyi.
11. Nestor meridionalis.
12. Coturnix novæ-zealandiæ.
13. Apteryx oweni.
14. Charadrius obscurus.
15. Anaryhnchus frontalis.
16. Hæmatopus unicolor.
17. Himantopus novæ-zealandiæ.
18. Himantopus albicollis.

Both Islands and Chathams only.

1. Athene novæ-zealandiæ.
2. Halcyon vagans.
3. Prosthemadera novæ-zealandiæ
4. Anthus novæ-zealandiæ.
5. Rhipidura flabellifera.
6. Carpophaga novæ-zealandiæ.
7. Thinornis novæ-zealandiæ.
8. Ortygometra affinis.

Both Islands and Aucklands only.

1. Hieracidea novæ-zealandiæ.
2. Hieracidea ferox.
3. Anthornis melanura.

Both Islands, Chathams, and Aucklands.

1. Platycercus auriceps.

Both Islands and Habitats outside of them, and of the Chatham and Auckland Islands.

1. Circus gouldi.
2. Zosterops lateralis.
3. Platycercus novæ-zealandiæ.
4. Eudynamis taitensis.
5. Chrysococcyx lucidus.
6. Charadrius fulvus.
7. Charadrius bicinctus.
8. Strepsilas interpres.
9. Hæmatopus longiristris.
10. Ardea alba.
11. Ardea novæ-hollandiæ.
12. Ardea sacra.
13. Ardea maculata.
14. Ardea pœciloptila.
15. Limnocinclus acuminatus.
16. Limosa baueri.
17. Recurvirostra rubricollis.
18. Himantopus leucocephalus.
19. Tringa canuta.
20. Rallus philippensis.
21. Ortygometra tabuensis.
22. Porphyrio melanotus.

North Island only.

1. Pogonornis cincta.
2. Orthonyx albicilia.
3. Petroica toitoi.
4. Petroica longipes.
5. Turnagra hectori.
6. Glaucopis wilsoni.
7. Heteralocha acutirostris.
8. Apteryx mantelli.
9. Ocydromus earli.

South Island only.

1. Zenicus gilviventris.
2. Orthonyx ochrocephala.
3. Sphenœacus fulvus.
4. Certhiparus novæ-zealandiæ.
5. Petroica albifrons.
6. Turnagra crassirostris.
7. Glaucopis cinerea.
8. Aplonis zealandicus.
9. Nestor occidentalis.
10. Nestor notabilis.
11. Apteryx australis.
12. Apteryx haastii.
13. Ocydromus australis.
14. Ocydromus fuscus.
15. Ocydromus brachypterus.
16. Notornis mantelli.

Chathams only.

1. Anthornis melanocephala.
2. Sphenœacus rufescens.
3. Gerygone albofrontata.
4. Petroica traversi.
5. Cabalus modestus.
6. Rallus dieffenbachii.

Aucklands only.

1. Gallinago aucklandica.
2. Rallus brachipus.

North Island and Chathams only.

1. Gallinago pusilla.

South Island and Chathams only.

1. Petroica macrocephala.
2. Rhipidura fuliginosa.

Occasional visitants from Australia and Tasmania.

1. Hirundo nigricans.
2. Eurystomus pacificus.
3. Graucalus melanops.
4. Charadrius ruficapillus.
5. Nycticorax caledonicus.
6. Platalea regia.
7. Numenius cyanopus.
8. Numenius uropygialis.

Art. XV.—*On two new* Isopods. By Charles Chilton, M.A.

[*Read before the Philosophical Institute of Canterbury, 6th April*, 1882.]

Plate XXIIa.

Genus **Cymodocea**, *Leach.*

(Generic characters given in Miers' Catalogue N.Z. Crustacea, p. 113.)

Cymodocea cordiforaminalis, sp. nov. Pl. XXIIa., fig. 1.

Body rather convex, slightly more than twice as long as broad. Head much broader than long, eyes rather large. Segments of thorax smooth, or only minutely granular, coxæ of all densely covered with rather long, very fine, woolly setæ. First segment rather longer than the others, next five equal in length, last longer, produced backwards at its postero-inferior margin, posterior margin slightly convex, overlapping the abdomen. Abdomen of two segments; the first showing on each side impressed lines indicating that it is composed of three or perhaps of four segments, having an irregular row of small rounded tubercles, posterior margin straight in the centre, produced backwards on each side into the last segment. Last segment very convex, bearing on the convex part several round tubercles of various sizes, the largest being near the median line and in the anterior part of the segment. The two lateral portions on each side of the terminal notch produced backwards and inwards, so as to meet in the median line, the central tooth small and sharply-pointed, so that what is really the terminal notch appears as a heart-shaped opening in the end of the abdomen. Last pair of pleopoda with the rami equal, reaching very slightly beyond the end of the abdomen. Inner ramus with its inner edge entire, outer margin at first entire but distally curved and irregularly toothed and fringed with setæ. Outer ramus thickest about the middle, proximal portions of margin entire, distal portions dentate, more distinctly so at the extremity, and fringed with setæ.

Inner antenna with first joint of peduncle very stout, second also stout, third as long as the first but slender, being about four times as long as broad; flagellum shorter than the peduncle, of about 9–10 joints, bearing simple auditory cilia. Outer antenna with peduncle of five joints, first three subequal, fourth a little longer, fifth nearly twice as long as the fourth, narrow at proximal end but widening distally; flagellum longer than peduncle, of about 15 joints, each bearing a small tuft of short setæ. First pair of legs with basos and ischios long, the latter bearing on its outer distal margin four or five short stout setæ, meros broader than long, carpus small, propodos ovate with setæ on inner edge, some being plumose, dactylos large and strong, the end forming a claw distinct from the basal portion.

Colour—dark brown, usually with a white median streak on the anterior part of the thorax.

Length, about $\frac{1}{8}$ of an inch.

Hab. Lyttelton Harbour.

This species can be readily recognized by the peculiar character of the terminal notch of the abdomen. This appears, however, to be subject to some variation, for in one small specimen the median tooth was represented only by a very small rounded projection, and in another of the ordinary size the two lateral portions of the abdomen did not quite meet in the median line.

Genus **Jaera**, *Leach.*

(Bate's and Westwood's Brit. Sessile-eyed Crust., ii., p. 314.)

"Upper antenna very short. Lower antenna more than half the length of the animal. Legs uniform slender. Pleon coalesced into one segment, furnished with two minute subterminal uropoda. Pleopoda or branchial appendages covered by a large plate occupying the entire under surface of the pleon. Dactyla biunguiculate."

Jaera novæ-zealandiæ, sp. nov.

Body narrow elliptical, length about two and a half times the greatest breadth. Head subrectangular, slightly more than twice as broad as long, produced into a slight median lobe between the antennæ. Eyes small, situated near the middle of the lateral margins. Inner antenna reaching to the third joint of the outer antenna, no flagellum distinguishable, basal joint very much larger and broader than any of the others, second and fifth joints equal and longer than the third and fourth, which are equal to one another, sixth (terminal) joint small, setæ few and short. Peduncle of outer antenna of five joints, first two equal and longer than the third, fourth and fifth equal and longer than any of the others, flagellum a little longer than the peduncle. Legs equal, all with propodos slender and longer than carpus, dactylos short ending in three curved hooks. Segments of thorax with short stout setæ on the lateral margins. Pleon nearly circular, lateral margins with short setæ, slightly emarginate at the base of the last pair of pleopoda. These are lateral, being situated at some distance from one another; they are short, each consisting of a short peduncle bearing two branches, inner one about as long as the peduncle and nearly twice as long as the outer branch, both tipped with short setæ.

Length, about $\frac{1}{10}$ of an inch.

Hab. Lyttelton Harbour.

This species resembles *Janira* and *Asellus*, and differs from *Jaera* in having the two terminal pleopoda separated from one another and not closely approximated in the centre as in *Jaera*; in other respects, however, it agrees well with *Jaera*.

DESCRIPTION OF PLATE XXIIA.

Fig. 1.	*Cymodocea cordiforaminalis,*	from above × 13.
1*a*.	,, ,,	inner antenna × 30.
1*b*.	,, ,,	outer antenna × 30.
1*c*.	,, ,,	first thoracic leg × 30.
1*d*.	,, ,,	abdomen from below × 24.

ART. XVI.—*On two Marine Mites.* By CHARLES CHILTON, M.A.

[*Read before the Philosophical Institute of Canterbury, 6th April,* 1882.]

Plate XXIIB.

AMONG some Crustacea collected from Lyttelton Harbour I have found two specimens of mites, belonging to two different species.

According to Semper,* sea-mites are "by no means rare." Gosse has described three English species, one belonging to the genus *Pachygnathus* (Dugès) and the other two to the genus *Halacarus*, specially made for them. As my specimens appear to resemble these two latter sufficiently to be placed in the same genus, I have ventured to describe them.

Genus **Halacarus,** *Gosse.*

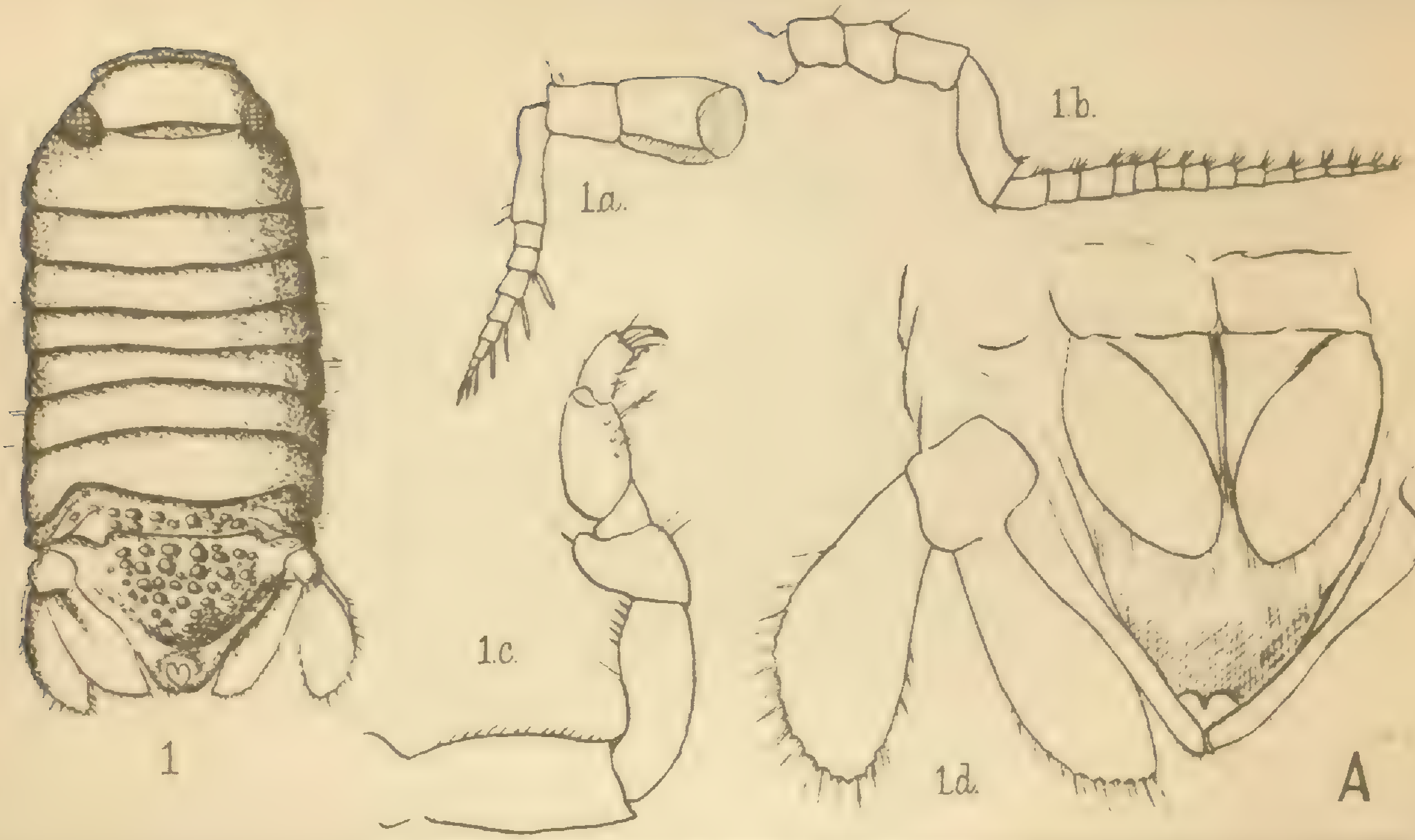
(Annals & Magazine of Natural History, ser. 2, vol. xvi., p. 27.)

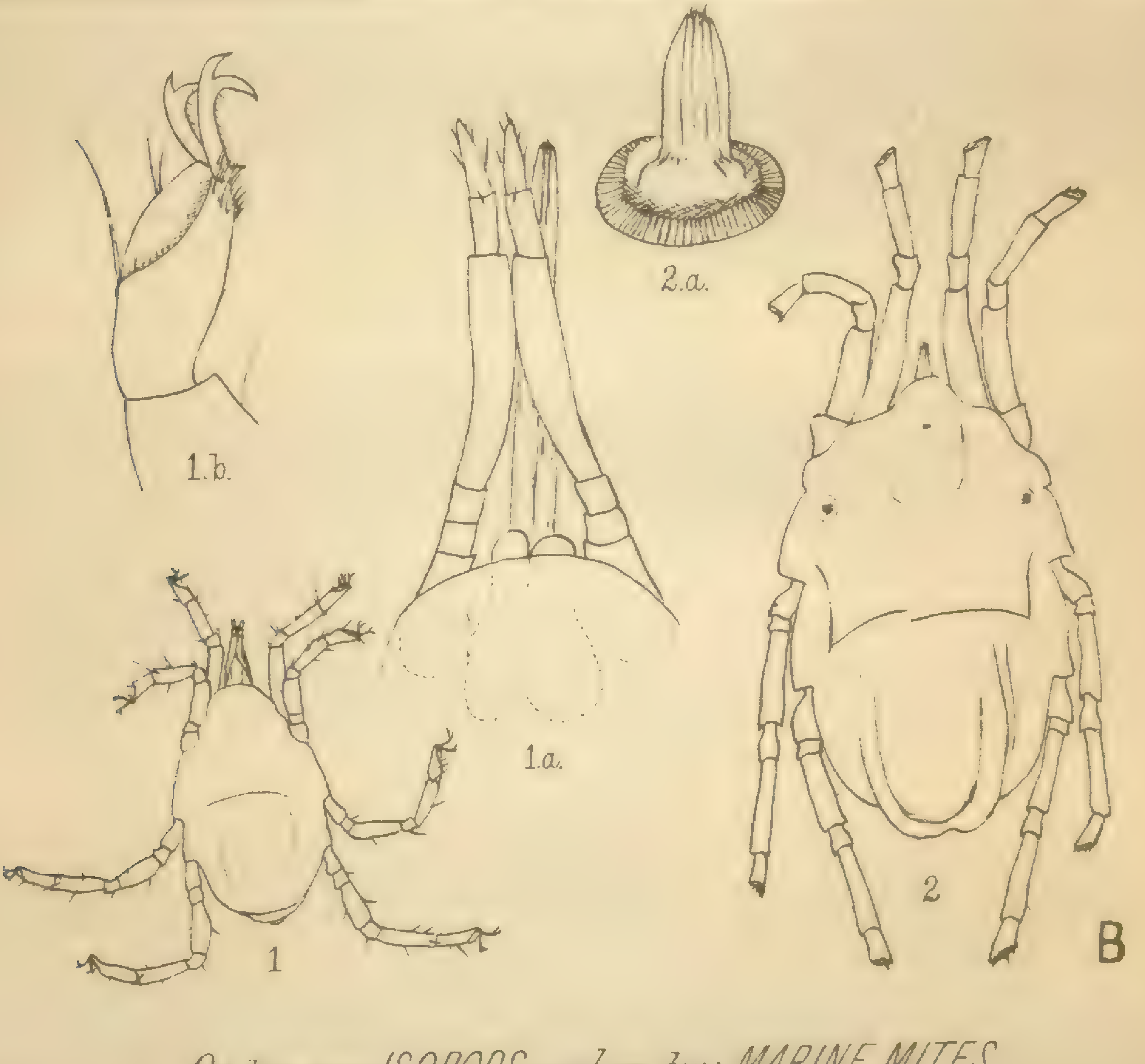
"Body covered above with a well-defined shield, either entire or transversely sulcated; under surface divided across the middle; rostrum headlike consisting of a bulbous tip, tapering to a point, divided longitudinally beneath, allowing the protrusion of a pair of slender filiform mandibles; palpi terminated by a fang-like unguis; feet cursorious, tipped with two falcate ungues; directed two forward and two backward, thighs remote. Marine."

Halacarus parvus, sp. nov. Pl. XXIIB., fig. 1.

Body oval, narrower in front than behind; notched at the bases of the legs, a slight transverse depression between the bases of the third pair of legs, anterior margin between the bases of the first pair of legs convex. First two pairs of legs arising close together, third and fourth more remote from one another. Legs subequal, third and fourth very slightly longer than the first and second and with fewer setæ; all with the first two joints short, third long and somewhat expanded, fourth short about as broad as long, fifth about as long as the third, last joint about two-thirds as long as the fifth, bearing two very movable curved hooks, each of which has two teeth at the end, the main one being larger and more curved than the

* Animal Life (Inter. Nat. Sc. Series, vol. xxxi.), p. 433.





C. Chilton, del. *On two new ISOPODS and on two MARINE MITES.*

accessory one ; proximal part of the concave edge of the main tooth and the concave edge of the secondary tooth, pectinated. The last joint of the leg has two or three long setæ on its outer edge and many short ones at the base of the two hooks ; a portion of the end appears to be hollowed out so as to form a resting-place for the hooks when they are bent back upon the joint. A few setæ are scattered over all the joints of the legs.

Palpi of six joints ; basal one rather large, partly concealed when seen from above by the anterior margin of the shield of the body, second and third joints short, about as broad as long, fourth very long, slightly expanding distally, fifth joint small, about twice as long as broad, sixth slightly longer than the fifth, tapering at the end and bearing a few short setæ. Each palp is directed inwards so that the two meet and the distal half of the inner margins of the fourth joints are in contact. Below can be seen the rostrum, which is long and slender, reaching almost to the end of the palpi. Anus terminal. Vulva enclosed in a circular space a little anterior to the anus.

No eyes visible. Colour, light brown.

Size of body, excluding rostrum, about $\frac{1}{40}$ of an inch.

Hab. Taken between high- and low-water marks, Lyttelton Harbour.

Halacarus truncipes, sp. nov. Pl. XXIIB., fig. 2.

Body elliptical, deeply notched at the bases of the third and fourth pairs of legs, less so at the bases of the first and second pairs, a notch on each side just behind the second pair of legs, slightly produced in front so as to form a rounded lobe between the first pair of legs. Eyes three, one median, very small a little behind the anterior margin of the head ; the other two forming a pair, one on each side just behind the second pair of legs and near the marginal notch already mentioned, each of the paired eyes enclosed within a circular mark. Body-shield with a transverse depression midway between the bases of the third and fourth pairs of legs. This does not extend right across the body, but is met on each side by a slight longitudinal depression extending anteriorly and outwards as far as the bases of the third pair of legs. Behind the transverse depression are two longitudinal ones extending right to the end of the body, the enclosed median portion is raised above the lateral parts, especially on each side next the depression, thus forming two slight ridges which meet behind. Anus on the under side of the animal a little anterior to the end of the body, vulva enclosed in a circular space a little anterior to the anus.

Body divided below by a transverse depression midway between the bases of the third and fourth pairs of legs, this depression met on each side by a longitudinal depression ; these two longitudinal depressions extend backwards and converge, meeting just behind the anus.

Legs equal in size and similar in form. First joint short, expanding distally; second very short, as broad as long; third long, rather slender; fourth short; fifth about as long as the third, slender; sixth about half as long as the fifth, end oblique, no hooks of any kind distinguishable, only one or two short setæ at the end of the joint. All the legs almost entirely free from setæ.

Rostrum short, no palpi visible. When seen from below it appears to arise out of a circular depression bordered by a stiff fringe. The rostrum appears to contain lancet-shaped organs of some kind, but nothing more can be made out without dissection. Colour, brown.

Length, about $\frac{1}{15}$ of an inch.

Hab. Lyttelton Harbour, between tide-marks.

EXPLANATION OF PLATE XXIIb.

Fig. 1. *Halacarus parvus*, from above × 40.
1*a*. ,, ,, rostrum from above × 120.
1*b*. ,, ,, end of one of the legs × 244.
2. *Halacarus truncipes*, from above × 30.
2*a*. ,, ,, rostrum from below × 72.

Art. XVII.—*Occurrence of a Species of* Ophideres, *Boisd., new to New Zealand.* By R. W. Fereday, M.E.S.L.

[*Read before the Philosophical Institute of Canterbury, 30th November*, 1882.]

On the 13th March last a boy brought me a moth found fluttering in the grass in the yard at the back of my office in Colombo Street, Christchurch. It was alive and vigorous when handed to me, but, unfortunately in a very dilapidated condition, the forewings almost entirely denuded of scales, and the exterior margin of both wings frayed and jagged.

The moth precisely resembles—so far as the dilapidated state of the forewings admits of comparison—the *Ophideres archon* of Felder figured in Reise der Novara, Lep. 4, pl. cxiii., fig. 3.

In all probability it has been introduced in some way, and is not an indigenous species. Felder's specimen appears to have been taken in Siam.

The following is a description of the insect:—

Female.—General colour of body and appendages ochraceous and pale ferruginous grey; eyes large and prominent; palpi recurved, and ascending above the head the length of the third joint, third joint half the length of the second, clavate, resembling a drumstick, the nob black tipped with pale ochraceous, second joint densely clothed, the underside velutinous; proboscis robust, of moderate length; antennæ simple, rather more than

half the length of the forewing; forehead tufted; thorax probably crested, but denuded in the specimen under description; abdomen not extending beyond the hindwings, crested and villose towards the base, upper side luteous shading into ferruginous grey at the base; legs rather long, anterior tibiæ very densely clothed beneath with long flexible hairs, the intermediate tibiæ with one, and the posterior with two pairs of long spurs.

Forewings.—Upper side appear to be pale ferruginous-grey, clouded with ferruginous brown and purplish-grey markings, but are too dilapidated and denuded of scales for certain description. Under side, basal two-thirds luteous with a black band across the middle and the appearance of a broad dark marginal band.

Hindwings.—Upper side luteous, brownish at the base, with a very broad curved and abbreviated discal black band or patch, concave outwardly, and a broad black outer border abbreviated towards the anal angle, and ending opposite the hind end of the discal band. Under side similar to the upper side, but rather paler.

Length of body, 14‴; expanse of wings, 42‴.

Art. XVIII.—*Description of a Species of Butterfly new to New Zealand and probably to Science.* By R. W. Fereday, M.E.S.L.

[*Read before the Philosophical Institute of Canterbury, 30th November,* 1882.]

Family NYMPHALIDÆ, *Westwood.*

Genus (?)—**helmsi**, n. sp.

Male.—Head small; eyes naked, large and prominent; antennæ scarcely more than a third of the length of the costa of the forewing; shaft slender, club small, flattened, rather elongate, and slightly curved, but not hooked; tip of the club fulvous; palpi long obliquely ascending, a little wider apart at the tip than at the base, thickly clothed with long bristly hairs, terminal joint small and pointed, the hairs on the upper and lower edges and tip black, on the sides (both inwardly and outwardly) white; forelegs rudimental, rather slender, scantily clothed with long slender hairs; hindlegs with a pair of small spurs at extremity of the tibiæ; tarsi with two simple claws.

Primaries broad; costa convex from the middle to the tip; hindmargin nearly straight, slightly tending to concave; the costal and median nervures dilated at the base. Upper side of primaries dark-brown, a transverse fulvous band, extending in a slight curve from the subcostal to near the submedian nervure and thence bending towards and terminating about two

lines from the anal angle, the inner margin of this band crossing the median nervure at the point from which the third median nervule springs, and the outer margin at the point from which the second median nervule springs, a transverse fulvous band beyond the discoidal cell, and extending from the costa to the anal angle, and bent outwardly at the first median nervule and gradually attenuated thence to the posterior angle; another and narrower fulvous band extending from the costa midway between the apex and the last described band, and joining the latter below the subapical ocellus round which it bends and by which it is nearly severed; a subapical white-pupilled black ocellus on a dark ground: under side of primaries similar to the upper, especially the brown of the basal third and the fulvous bands near the costa, the inner and middle bands being confluent at the inner margin; the interior band from the ocellus to the costa silvered, also the middle band silvered on the costa, and a very narrow submarginal silver band from the costa to near the third median nervule.

Secondaries.—Discoidal cell closed; anal angle elongated (possibly caudate, but the anal angle of both hindwings is too much chipped to determine with certainty). Upper side of secondaries dark-brown; a submarginal fulvous band extending from the first subcostal nervule to the third median nervule; another fulvous band extending from the middle of the costa, and running into the submarginal band below a white-pupilled black ocellus which nearly severs the middle band—the latter ocellus situated in the space between the lower discoidal and the first median nervules, and above it a similar but less distinct ocellus, and above that an indication of another but obsolete ocellus—the three ocelli connected and occupying the space between the fulvous bands; a similar ocellus on the anal end of the submarginal band between the second and third medial nervules. Under side of secondaries brown but paler than the upper; the bands of the upper side indicated below by silver bands, but the inner completely severed from the outer by the lower of the three connected ocelli which are repeated as on the upper side, but each surrounded by a narrow pale brown ring, and the iris and pupil of each fully developed; the ocellus near the anal angle repeated as on the upper side, but surrounded by a broad fulvous ring; a very narrow submarginal silver band running from the anterior angle to the anal ocellus; a silver stripe along three-fourths of the inner margin from the base; a silver band extending from the costa near the base to near the anal ocellus, broad at the costa and attenuated to a point near the ocellus; and, between the latter band and the stripe on the inner margin, another narrow silver stripe.

Expanse of wings, 1″ 10‴.

Hab. Paporoa Range, near Greymouth.

I have described this butterfly from a single specimen submitted to me by Mr. J. D. Enys for description. He informs me that it was captured by Mr. R. Helms, of Greymouth, at an altitude of about 1,200 to 1,500 feet above the sea. Unfortunately the specimen is chipped and frayed at the anal angle of the hindwings, so that the caudate form of that angle cannot be exactly defined.

The genus of the insect I do not venture to determine, not having access to the descriptions of the various genera of the family to which it belongs.

There appears to be much confusion in the definition of the neuration of the wings of Lepidopterous insects—especially with reference to the notation of the nervules, or branches of the nervures, which are indicated by numbers—in consequence of some entomologists counting in a direction from the costa towards the inner margin, and others in the opposite direction. I have therefore thought it desirable to state that in the above description I have adopted the former notation, that is counting from the costa towards the hind margin, a notation which accords with that indicated in the diagram of "Terminology of the wings of *Papilionidæ*" given in "Catalogue of Lepidopterous Insects in collection of the British Museum, part 1, Papilionidæ, 1852."

I take the present opportunity of calling attention to the very incorrect reprint, in Mr. J. D. Enys' Catalogue of the Butterflies of New Zealand, 1880, of my diagram illustrating the difference of neuration in the wings of *Erebia blandina*, *Percnodaimon pluto*, and *Erebiola butleri*. The inaccuracy renders the diagram worse than useless, inasmuch as the object of my diagram was to show the position of the nervures and nervules, and in the diagram in Mr. Enys' Catalogue they are wrongly placed. Great care should always be taken in printing diagrams of this character.

Art. XIX.—*Description of two new Species of* Heteropterous Lepidoptera.

By R. W. Fereday, M.E.S.L.

[*Read before the Philosophical Institute of Canterbury*, 30*th November*, 1882.]

Fam. LEUCANIDÆ, Guénéé.

Genus **Leucania**, *Ochs.*

Leucania purdii, n. sp.

Male.—Head and thorax dark pinkish-ochreous-yellow, darkest in front; abdomen paler and greyish at base.

Primaries above dark pinkish cedar colour, a dash of ochreous-yellow occupying the areolet between the submedian nervure and the third median nervule, the dash being very bright at the base and fading towards the pos-

terior angle; a dash of the same colour commencing broadly in the middle of the discoidal cell, extending along the areolet between the first discoidal and lower subcostal nervules, and narrowing towards and vanishing near the exterior margin; a similar dash extending along two-thirds of the costa from the base of the wing; cilia, basal half ochreous-yellow, exterior whitish-ochreous. Primaries below greyish-ochreous with a pinkish tinge, costal part more ochreous, exterior area more grey; cilia as above. Secondaries above dark fuscous, paler at the base; cilia same as of primaries. Secondaries below greyish-ochreous, the exterior third more greyish, preceded by a darker greyish transverse narrow band running parallel with the exterior margin; discocellular spot greyish rather indistinct; cilia as above.

Length of body, 10‴; expanse of wings, 1″ 10‴.

Hab. Near Dunedin.

A single specimen taken by Mr. Alex. Purdie, of Fairfield, near Dunedin, from the roots of grass in an open field.

Leucania blenheimensis, n. sp.

Female.—Head, thorax, and abdomen very pale fawn nearly cream-colour.

Primaries above same colour, sericeous; a subterminal row of small blackish points, one on each nervule; the inner line indicated by a small blackish point on each of the subcostal, median and submedian nervures; all the nervures and nervules speckled with dark grey and white, especially near the junction of the subcostal and median nervures with their branches; cilia dark-grey, outer edge paler, whitish at points of nervules. Primaries below very pale whitish-brown irrorated with greyish-brown; central area and cilia darker. Secondaries above grey, with paler cilia. Secondaries below very pale whitish-brown irrorated with pale greyish-brown; cilia same colour.

Expanse of wings, 1″ 7‴.

Hab. Blenheim in the Marlborough Provincial District, and Meanee near Napier.

This insect was presented to me by Mr. William Skellon, then residing at Meanee, but now at Timaru. He informed me that he took it at Meanee at sugar, that he had taken two specimens there, and two at Blenheim, and that the Blenheim specimens were smaller than the Meanee. At his suggestion I have named this species *blenheimensis.*

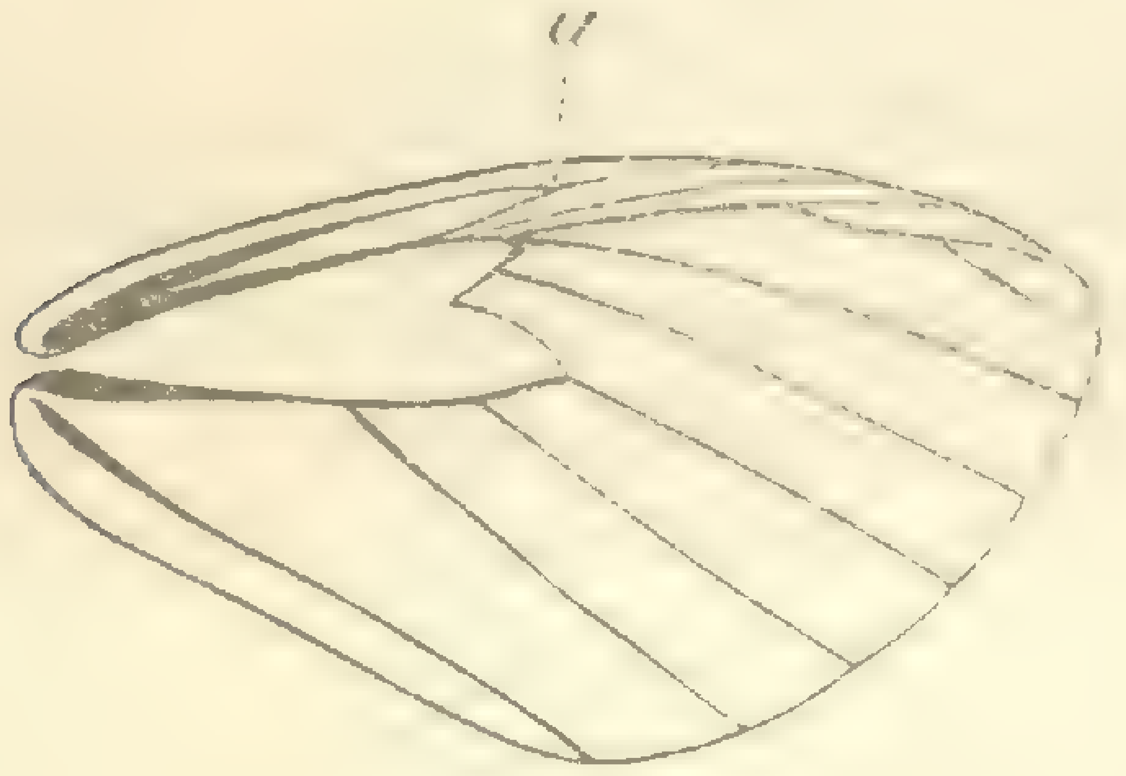
Art. XX.—*Note on a peculiar Neuration in the Wings of some Individuals of* Percnodaimon pluto, *a New Zealand Butterfly.*

By R. W. Fereday, M.E.S.L.

[*Read before the Philosophical Institute of Canterbury, 30th November*, 1882.]

When examining some specimens of *P. pluto* I noticed that the costal nervure of the primary wings of one of them was bent inwards and united to the first subcostal nervule, the united nervure and nervule running thence in one vein to the anterior margin, as shown in the annexed diagram, fig. 1*a*. In ordinary specimens the first subcostal nervule is not present, and the costal nervure is of the ordinary form as shown in the annexed diagram, fig. 2. (The diagram is twice the natural size of the wing).

1



2

The discovery of this peculiarity led me to examine very carefully all the specimens of *P. pluto* in my collection, and those in the collection of Mr. J. D. Enys. These collections consist of 33 specimens taken on a mountain near Mr. Enys' station, Castle Hill, Porter's Pass, 21 on Mount Hutt, and 1 on a mountain near Lake Guyon (Nelson Provincial District). Six males and one female of the Castle Hill specimens, four males of the Mount Hutt, and the one male of Lake Guyon, have the united veins, and are smaller, but in other respects do not appear to differ from the ordinary form. In all the specimens having the united veins, such veins are alike in form, position, strength, and point of junction, and all the other veins are uniform with those of the ordinary specimens. No other irregularity of neuration appears in any of the specimens, nor does there appear to be any other tendency to variation in the species.

Does the neuration of the wings of *Lepidoptera* furnish a reliable character for determining families and genera? I will not attempt to answer this question, but I submit the above facts for the consideration of entomologists.

Art. XXI.—*On Diseased Trout in Lake Wakatipu.* By W. Arthur, C.E.

[*Read before the Otago Institute, 15th August, 1882.*]

Plate XXIII.

For several years back the large trout in Queenstown Bay, Lake Wakatipu, have been a subject of notoriety and interest to visitors and others. These trout, in weight from 2 lbs. up to 15 lbs. or more, and in shoals of several hundreds, frequent the east margin of the bay near the mouth of the Town Creek, the reef at the end of the Peninsula, and the shore near the One-mile Creek on the west side. They appear quiet and lazy in habit, except when, as often occurs, they throw themselves with great vigour into the air.

It is also to be remarked that they are to be seen at these places both in summer and winter, caudal and dorsal fins on the surface, and an occasional one may also be observed in the middle of the bay or at the steam-boat jetty. The water is very deep throughout this bay, but has a shallow margin a few yards in width running round parallel to the beach. The great body of the lake itself is abysmal, the only sounding got as yet being at a depth of 1,300 feet. Along the east side of the Queenstown Bay there is a belt of weeds growing on the bottom on the outer edge of the aforesaid shoal-water, the bottom itself consisting of shingle, gravel, and sand. The water of the lake is remarkable for clearness and purity, and is snow-fed through the Dart, Rees, Greenstone, and such rivers, which drain the surrounding mountains of the Southern Alps. Dr. Black, of our University, remarks, on his analysis of this water, that he never examined any water so destitute of common salt—a fact of great importance as regards the health of trout. His analysis I may repeat is,—

	Organic Matter in Solution.	Table Salt.	Degree of Hardness.
Wakatipu—	0·5 grains per gallon.	Scarcely a trace.	3-1 degrees, very soft.

In summer storms are frequent on the Wakatipu, but in winter its surface is generally calm or nearly so. The trout *S. fario, ansonii*, Günther, were put into the feeders of the lake about the year 1874.

Besides the abnormal habit of great trout herding together in shoals, these Wakatipu fish almost without exception have refused the baits of anglers who have fished for them. The exception I refer to is that of a beautiful but small trout of 1½ lbs. weight, taken by Mr. J. P. Maitland with minnow, while fishing from the beach of Queenstown Bay in January, 1880. This fish was remarkable by its bright silvery scales, the absence of all spots excepting on one gill-cover, and the absence of teeth on head of vomer. The condition generally of these trout is suggestive of good living, as they are fat and sometimes very much so, and are said to possess excellent edible qualities. But for some years I have heard of the presence of

fungus among them, eventuating occasionally in the death of very large ones. It was only recently, however, that I was so fortunate as to see these trout and to observe this fungus on them. One morning in June of this year I took a walk round the shore, past the mouth of the small Town Creek already referred to. The water from this stream enters the bay at its north-east corner exactly, and in almost direct alignment with shoal water frequented by the trout, consequently the influence of the creek water is noticeable for thirty or forty yards along the shore. Here within a few yards of the mouth of the stream I saw several large trout quietly resting, but the great body of them was stretched along from this point for a distance of about a hundred and fifty yards, in three shoals or "schools," containing more than a hundred fish each, and distant from the water's edge as far as the belt of weeds grew. In weight I estimated them from 3 lbs. up to near 20 lbs. They all lay with their heads towards the creek mouth, except when one or two took a leisurely turn round and resumed their former position again, or when others evidently excited by some influence threw themselves wildly into the air, falling heavily, or splashed along the surface. They did not seem to care much for the presence of a human spectator, and in this their habits differ from what obtains in rivers or streams usually. Presently I was surprised to observe a trout of about 6 lbs. in weight, swimming within a rod of me parallel to the shore. As it showed no alarm I moved along with it, and then discovered that it was all covered with fungus. Concluding that it would probably soon die from its unnatural movements, I endeavoured to secure it for examination, but although I passed the crook of my stick easily over its tail, yet it resented the effort I made to draw it ashore, and swam off into deep water. Abandoning all hope of seeing this fish again, I examined as carefully as I could the other fish in the shoals, when I perceived easily, as the water makes the white spots very plain to the eye, that at least 25 per cent. of them had marks of fungus on their bodies. On the larger trout a patch or two of dirty white was seen on the head generally, and a tuft hanging out of the side of the mouth; while in breathing they could not close their jaws, and showed very little motion in them at all. Some of the smaller ones were worse, their bodies and fins being covered with spots or patches. The most of these trout were dark in colour, while one or two I occasionally noticed were light-coloured, but whether these were diseased or not I could not make out. So clear was the water, and so tame and subdued were the trout, that standing as I did on the shingle, I could plainly distinguish the sexes from one another in the larger individuals. I then walked along the beach towards the reef at the point of the peninsula, but saw no more trout till I reached that place. There, however, I soon saw a number of them, from

10 lbs. to 20 lbs. in weight, springing out of the water. These seemed also to be dark in colour as they rose to view in the air, leaping to a height of four or five feet. I may mention here that the previous night on visiting the beach I heard many trout splashing about and out of the water, so nightfall with its keener air did not put a stop to their gambols, or irritation, whichever it might be. Returning towards the point where I had seen ths diseased six-pounder, I observed one with its tail-fin out of the water, belly up and head on the bottom, in shallow water, drifting ashore. Wading in I seized it by the tail and easily ran it out and laid it on the shingle. As it was nearly dead I did not kill it, and in a few minutes it succumbed. It was evidently the same trout that I had been watching half an hour before, as it had the identical fungus marks I had been observing, and it weighed 7½ lbs. The fish was a female trout, fat, but dark in colour, badly spotted on dorsal and all the other fins with fungus; the gills were full of it, and a tuft hung out of the right side of the mouth, while the back and sides had a number of distinct marks or patches, some appearing as if due to the mucous covering having been eaten away by the disease. The margin of right opercula and origin of right pectoral fin were also eaten away. Lying on the beach near the creek mouth I saw the skeletons of two other trout which had evidently come ashore after death.

Examination of the Diseased Trout.

The same evening, twelve hours after getting this trout, Dr. Douglas, of the Wakatipu Hospital, and I made an examination of it. Immediately after death it had visibly swelled, and continued to do so till the abdomen became very much distended—a thing which never occurs with healthy trout. On opening it we found it full of ova nearly ripe, the roe-lobes having a hard appearance; pyloric cæca fatty, but not healthy; stomach quite empty, and air-bladder very much swollen with gas. The other viscera seemed healthy. A number of the blood-vessels lining the abdominal wall were full of coagulated blood, but that is not unusual. The teeth on body of vomer were gone and the gills were of a dull purplish hue. In attempting to remove a patch of fungus from the gills it could not be separated, so firmly had the roots taken hold, and the tissues came away easily with it. The gills, in fact, were rotting.

A small portion of fungus placed under the microscope showed a form and structure remarkably like *Saprolignia ferax* (figs. 1 and 2, pl. XXIII.), and, so far as I can judge, apparently the same disease; but of that I cannot be positive. Plenty of long sacs full of spores were present, with innumerable free cells floating about them, and some in circular sacs resembling *Ogonium* (or spherical sac containing spores and supported by short stems), but destitute of stems. No sacs were seen in the protoplasm

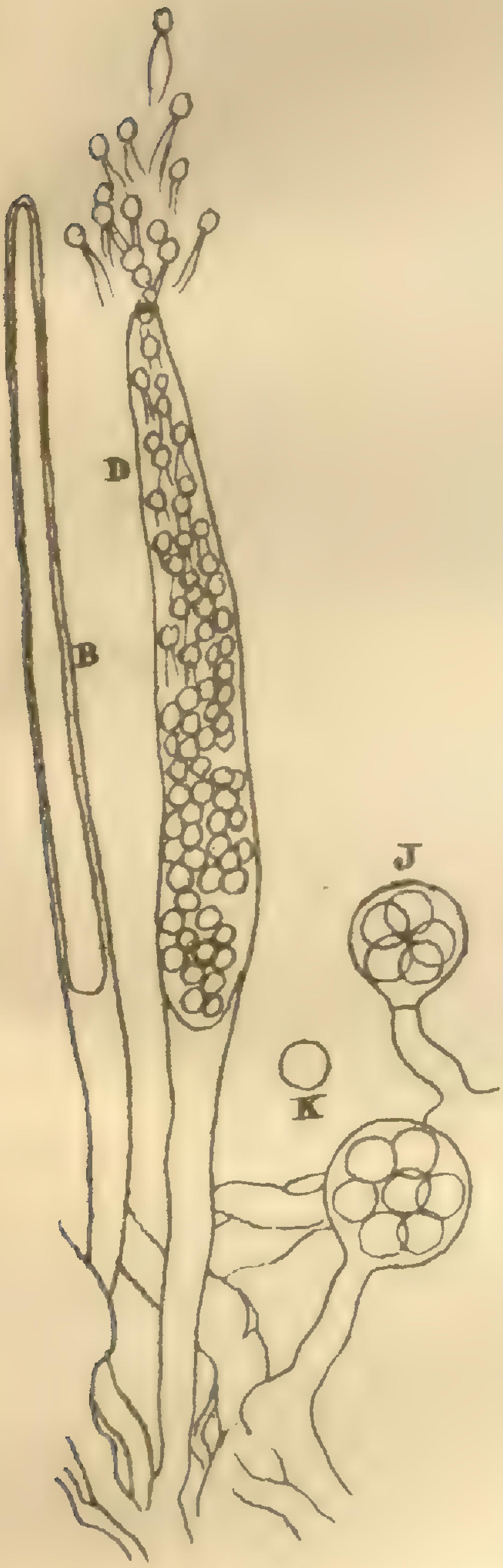


Fig. 1

SAPROLEGNIA FERAX.

(from Salmon Com.rs Report 1880.)

B, Protoplasm; D, Zoöspores; J, Ogonium; K, Resting spore.

Fig. 2.

FUNGUS ON WAKATIPU TROUT.

X · 600

Salmon Fungus and Trout Fungus.

W.A. delt.

stage or without cells, and the cells themselves were exceedingly minute, just visible clearly under a two-inch objective. A subsequent examination made since returning to town (the fungus meanwhile having been preserved in glycerine and boracic acid) gave similar appearances, but no *Ogonium*. It, however, revealed the fact of the spores being contained really in an inner sac or tube, the space between which and the outer covering of the main sac appeared to be full of a colourless fluid. From the appearance of this trout and that of others in the shoal from which it was taken, it is manifest that these fish are in a chronic state of disease, and that not confined to this the spawning season, for I have ascertained the presence of fungus at other times, as in the month of March of this year. And here it may be observed in passing that fungus has been found on trout at the Wallacetown ponds in 1876, and recently a Marlborough gentleman told me of his taking out of some still pools in a stream in that district fungussed trout years ago, while our native fish the *Galaxias* and silver fish are not always free from it. At the same time the identity of the fungus among all those fish has not been determined. A consideration of the above facts naturally suggests two questions, first, *what is the cause of*, and second, *what the cure for*, the fungoid disease in the Wakatipu trout.

The Cause of the Disease in the Wakatipu Trout.

In the first place, so many difficulties surround the investigation, that the cause or causes of the disease cannot well be presumed to be stated exhaustively. At the same time, so far as our knowledge of the habits of trout and of the conditions necessary to their healthy life enable us to judge, we are warranted at least in advancing an opinion. I assume then that the trout in Queenstown Bay were spawned in the Town Creek, a stream far too small for the subsequent accommodation of the size of fish to which these attain. Growing too large for this stream they have naturally dropped down to the lake during floods, and when there have so increased in size in the course of a few years as to become physically incapable of again ascending the stream at their regular spawning season. No stream large enough seems to be sufficiently near, and the great depth of water along the shore to the west, without leading shoals, tends to confine the trout so to speak to one place, or at least to operate against their migration in that direction. In this respect the Wakatipu is totally different from the streams where the progenitors of our trout live in England, where the water does not probably have a greater average depth than four feet. With the true instincts of the Salmonidæ, however, the trout in Queenstown Bay linger near their parent stream, unable so to speak to convince themselves how it is they cannot be again admitted, and, diseased as they have become, presenting an appearance suggestive of the lame and sick folk of old who

waited for the "troubling of the water." Being unable then to fulfil the functions of nature at the spawning season, is the first contributing cause to the outbreak of the fungus.

Again the chemical constituents of the water have an important bearing on the health of the trout. Trout under domestication when attacked by fungus have in almost all cases been cured by the addition of common salt to the water supplying the ponds or tanks containing the fish, provided the disease has not been permitted to go too far. As already mentioned, Dr. Black reports that the Wakatipu water has less salt in solution than any water ever examined by him. Now, as salt is an essential to health in trout, its entire absence in the water under consideration must act prejudicially on these fish. This is the second and only known cause tending to accelerate the outbreak of the disease. But there is yet another cause which I suspect, although not in a position to prove, namely,—the absence of a due proportion of oxygen among the gases held in solution by the water. To determine this, not only is a gaseous analysis required, but it is also necessary to find out what that quantity of oxygen is which trout require. Science has yet to discover this ratio so far as I know, and it is an important element in its bearings on this question. As already stated, the fact of the trout seeking those places, as the mouth of the creek and the reef, where oxygen is likely to be most abundant owing to the constant agitation of the water, shows that the instincts of these trout teach them to look for water where the best aeration is to be found.

These causes, then, seem to me sufficient to prove that the disease among the Wakatipu trout has been consequent on functional derangement, and that this has so lowered the vital force of the fish as to leave them powerless to resist the attacks of the fungus, a plant which the best authorities tell us is present in all fresh waters.

Can the Disease be cured in the Wakatipu Fish?

And here I confess that, considering the unfortunate situation of these trout in Queenstown Bay, no ordinary remedy could be applied efficiently. For although the submergence of rock salt at the places frequented by the fish, and the artificial increase of the water supply to the Town Creek, might probably lessen the extent of the evil, yet these applications could effect but a partial and temporary check on the disease. Moreover, there would be no finality to these operations, and their cost would exceed the means of the local Acclimatization Society I fear. No doubt it would assist if the trout were netted and all affected fish killed and burned; but in this there might be no finality either, still it ought to be done. While I am bound then to admit that I see no specific cure of an easy and cheap nature, there is yet hope, I think,

from a most unlooked-for quarter—that is in the disease itself. For you may remember that I have mentioned the circumstance of finding the remains of only two trout on the beach, and, from anything I could learn, these trout, frequenting the same localities, have not as yet died in large numbers at a time. It is possible, therefore, that this fungoid disease, loathsome in appearance and widespread as it certainly is among the shoals, may either die out, or so inoculate the healthy fish, as in process of time to render them proof against severe attacks. A correspondent of "Land and Water," in the number of that journal for March 25th, 1882, records his having seen trout in the river Kent which had been affected by fungus and had recovered without any artificial treatment. Nature, then, may yet work out a recovery among the Wakatipu trout in her own time and way; but that must be assisted by our providing facilities for natural spawning in the Town Creek.

ART. XXII.—*Notes on the New Zealand Sprat.* By W. ARTHUR, C.E.

[*Read before the Otago Institute, 15th August, 1882.*]

Plate XXXIV., fig. 1.

THIS fish has been described by Dr. Hector in the appendix to his Catalogue of New Zealand Fishes, and was subsequently figured (Trans. N.Z. Inst., vol. v., pl. xii.); but, as it appears on our coasts at considerable intervals of time only, I deem it may be useful for reference to record its recent reappearance accompanied by a drawing of the form found in our waters, and a description sufficient to establish its identity.

The specimen which I have figured, and will call No. 1, is a male sprat, taken in the sea at Oamaru in May, 1882, out of a large shoal which came in to the coast at that date. The body is compressed laterally, dorsal outline slightly arched, abdominal deeply curved; head one-fifth total length; maxillary curved, with posterior extremity rounded accurately, posterior half of bone free, disconnected from head and quite transparent in colour, does not project beyond vertical from anterior margin of orbit; mouth small and round, lower jaw very prominent and projecting beyond intermaxillary one-tenth of an inch when mouth open as in figure. Operculum nearly vertical in outline but sinuous, preoperculum with a distinct lower limb, no striæ. One dorsal fin, caudal forked, belly-fins very fine, origin of dorsal and ventral fins in same vertical line. Lateral line barely visible, abdominal serrature not very prominent, but fourteen bars mark the space very distinctly between pectoral and ventral fins, apparently the external impression of the hæmal spines. Scales cycloidal, large, and deciduous.

Eye very large and round, iris yellow, pupil bluish-black. In *colour* the back is of an indigo hue shaded down into the brilliant silvery sheen of the sides and belly; dorsal and caudal fins dark; pectoral, ventral, and anal fins light olive yellow.

Dimensions.—Total length, $4\frac{9}{10}$ in.; depth, $\frac{19}{20}$; head $1\frac{1}{10}$; eye, $\frac{26}{100}$; least depth of tail, $\frac{4}{10}$.

Fin rays.—D, 16; P, 18; V, 9; A, 22; C, 21–$\frac{4}{5}$; longest ray, $\frac{15}{20}$; shortest, $\frac{6}{20}$ in.

Length of fins.—D, $\frac{11}{20}$; P, $\frac{7}{10}$; V, $\frac{4}{10}$; A, $\frac{18}{20}$ in.

Branchiostegal rays, 6. *Scales.*—L. lat. 55; L. trans. 15.

Teeth.—The teeth in this specimen were scarcely perceptible to the touch and very minute.

On examining the viscera I found a thin silvery lobe 2 inches long, which I take to be the air-bladder. It was remarkably like the lobe of the Scotch herring, but the fish was rather old when opened.

Specimen No. 2.—This is a female from the same locality as the male and obtained at the same time.

Dimensions.—Total length, $4\frac{7}{10}$ in.; depth, $\frac{85}{100}$; head, $\frac{9}{10}$.

Fin rays.—D, 18; P, 17; V, 8; A, 17 (injured); C, 22–$\frac{4}{4}$.

Branchiostegal rays, 6.

Vertebræ, 56.

Teeth.—Very minute, but perceptible to touch on mandible, intermaxillary, and tongue.

Under the microscope four or five teeth were plainly seen on the intermaxillary, with some rudimentary ones. On mandible a few were seen very distinctly, one of the largest being a perfect cone, broad at base, clear and transparent, and about $\frac{1}{3000}$ of an inch long. I also could make out six or seven others on same bone, but not so shapely and of irregular sizes.

The *ova* of this female, in two lobes each $1\frac{1}{2}$ inch long, were well developed. So light were they that in placing one lobe into fresh water it floated, and sunk very slowly when wetted all over its surface afterwards. No individual ovum was visible to the unassisted eye, but under the microscope the ova appeared to have an irregular pentagonal outline, covering an interior circular core full of cells. The space between core and outer covering also held some cells, but not so closely packed as in the core, while all the ova were surrounded by a jelly-like mass of fluid full of free cells. The diameter of each egg was about the $\frac{1}{1550}$ part of an inch.

Ova of *Clupea sprattus* × 1550.

This beautiful little silvery fish is mentioned by Dr. Hector as having been found in Foveaux Straits and near Wellington in 1872 (see Cat. N.Z. Fishes, p. 133). A fishmonger in Dunedin remembers it being in the

market about eight years ago, so probably he means or refers to the same date as above, although he could not tell me very exactly the time of the occurrence. Neither can I find that this herring has been again seen on our coasts till May of this year, when it appeared in large numbers for a short time, as I have said, at Oamaru, close inshore, about a fortnight altogether; then bad weather set in, and it has not been heard of since. The shoals did not visit Moeraki Bay, nor Dunedin Harbour, but those fish caught were sent to Dunedin, and were found to possess good edible qualities.

As to the habits, reproduction, and growth of this fish we know less than the little which is known of the British herring. Possibly, however, the sealers and whalers, still living, may possess information which would be of great interest in elucidating its natural history. Meantime one circumstance may fairly be inferred from the minuteness and buoyancy of the ova, which is, that in whatever depth of water spawning may take place, the hatching will occur on the surface of the sea in all probability. I have made a rough calculation from the size of the roe-lobes and find that one of these fish will contain over 20,000,000 ova! This is an almost incredible number, and would require verification by an examination of a number of other individuals when an opportunity again occurs. I may mention, however, that Mr. Frank Buckland, in his Natural History of British Fishes, gives approximations to the above number in the roes of the turbot and conger eel, which are given at 14,000,000 and 15,000,000 eggs respectively. The great number of ova in this sprat is suggestive of a very heavy death rate due to this species of herring being probably the food of the seal, whale, and predatory fishes, as well as of marine birds.

The fact of these fish visiting our coasts at considerable intervals of time, points to another circumstance which may regulate their movements. Dr. Parnell in his "Fishes of the Forth," describes the British form of the sprat as being very sensitive to cold, and that on the approach of winter it ascends the estuary of the Forth to the brackish water in search of a warmer locality. An old theory was also held by Pennant that the herring migrated to the arctic seas before winter. While there is much evidence of the presence of herring on the British coasts during winter, there is nothing against the probability of some of the species absenting themselves in the direction indicated at that time of the year. Be that as it may, if our sprat is as sensitive as its British representative, a reason would exist for its migration from more northern waters to the antarctic seas after our summer is past. For a warm current is believed to flow from the tropical region of the Pacific

Ocean towards the south pole, but which is separated from the east coast of Otago by a cold northerly littoral current. As the boundaries of these currents fluctuate a good deal according to the season and direction of the winds, a deviation of the warm southerly stream towards Otago at the time of the migration of the sprat would account for their occasional appearance as well as their disappearance. At present, however, there is not much more known of the great currents of the South Pacific Ocean, than of the habits of this little herring itself.

NOTE.

Since the above was read, a good deal of interesting information not previously ascertained by me, has been kindly placed at my disposal relative to above species. It is from Mr. P. F. Stoddart and Mr. Cosgrove. Mr. Stoddart says: "For years prior to 1875, when I was living near Moeraki, the sprat visited the Fish Reef regularly from March till May in incredible numbers, which were easily seen by us while fishing there, as they came close under our boat. They always disappeared on the approach of cold weather. The red cod which we caught on the reef were often found to be stuffed full of sprats,—indeed they were sticking out of their mouths." The Fish Reef lies about three miles off shore.

In a subsequent letter from the same gentleman, he adds:—"I have made enquiries about the sprats. Captain Liddle (who has been fishing at Moeraki for the last fifteen years) says, they are there every year in any quantity, about the reefs a mile from the shore. They begin to appear about January, but are most plentiful in March and April. On two occasions during that period they came inshore, into Moeraki Bay, in dense masses, as they did also at Oamaru and Timaru. He could give me no information which way the shoal travels, as they seem to be all over the sea; and accounts for their going close inshore, sometimes in dense masses, to other fish pursuing them.

"Mr. Leggatt, who used to have the landing service at Port Moeraki and is now in Christchurch, also knows the fish very well and remembers his boys getting buckets full, left among the holes in the rocks by the ebb-tide, some four or five years ago. Captain Liddle says, that with a hoop-net, which he sinks a few feet at the stern of the boat and then throwing over some food, he can catch any quantity any year. There were plenty at Moeraki at the same time (May, 1882) these shoals were in Oamaru Bay, but they did not come close in the same."

Mr. Cosgrove writes me:—"It makes its appearance on the east coast of the Otago Peninsula in the month of November and remains off the coast of the South Island throughout the season, which is, so far as I can gather from searching enquiries and from personal observation, from

November to end of March. When first seen the shoal is usually travelling southward; still this is not invariably the case, as I have on one or two occasions seen it head towards the north. The direction in which the shoal is moving can at any time be ascertained by watching the movements of the mutton-birds (*Puffinus tristis*). These birds follow the shoals in vast numbers, indeed I might say, in myriads. So great are their numbers that I have seen a portion of the surface of the water, several square acres in extent, literally black with them.

"The shoals pass and repass the coast between Ocean Beach and Sandfly Bay several times during the season, at a distance of from a quarter of a mile to two miles from the shore, according to the state of the weather. Should the sea be very calm, with a gentle breeze from the land, they are almost sure to come inshore.

"For many years in succession they came in at Sandfly Bay, a beautiful spot at the foot of Mr. W. Robertson's property; but they have only twice visited that harbour during the last five years. When, however, the sprats do come in, either at this place or any other place along the coast, they come so close that all the pools around are actually packed with them, and when the tide ebbs the silvery little creatures may be seen turning over on their backs in thousands dying from want of oxygen.

"Mr. W. Robertson informs me that the shoals have passed Sandfly every year since he settled there in 1860, and that in 1881 a shoal came in for a few minutes but went out again, and passed on towards the south.

"The shoals are sometimes followed by great numbers of red cod, barracouta, groper, and dogfish, and these again are followed by seals. When such is the case, the scene from the shore baffles description. On the outside of the shoal are terns, gulls, and mutton-birds, fighting and screaming over their prey; while beneath are the large fish above-mentioned driving the sprats towards the surface; and added to the noise of birds and fish you hear the sudden splash and short bark of some three or four seals. So pressed have I seen a shoal, that several square yards of the fish were raised quite out of the water by the efforts of the sprats at the bottom to get out of the way of their enemies' attacks from below. On one of these occasions I caught six large dogfish by means of a large hook lashed to a long rod. As these fish lay struggling on the rocks, sprats came sliding and even jumping out of their mouths in great numbers!

"As an article of food the sprats are really excellent. When fried in olive oil they are deemed a luxury by the most epicurean. As to how they could be caught for market, when offshore, I dare not venture an opinion; but when they are inshore, I can with confidence affirm, that they could be caught in great quantities with hand-nets alone. Indeed, so numerous are

they at these times, that a man standing on the rocks could lift them out of the shoal with a shovel. There are many other interesting facts which I have not mentioned here, but as you may already be wearied I will conclude, hoping you may be able, from these rough notes, to glean such information as you require."

My enquiries, before writing above paper, being confined to the fishmongers in Dunedin—is the explanation of the difference as to the appearance of this fish on the coast between my opening remarks and the notes just added. But the times known only to the fishmongers, are no doubt those when these fish come or are driven very close inshore. As the great body keep seemingly well out from the beach, and as an article of food this herring is very good, it ought to be searched for and netted by the fishing-boats of our new Deep Sea Fishing Company.

Art. XXIII.—*Notes on the Picton Herring*, Clupea pilchardus (C. sagax, New Zealand form). By W. Arthur, C.E.

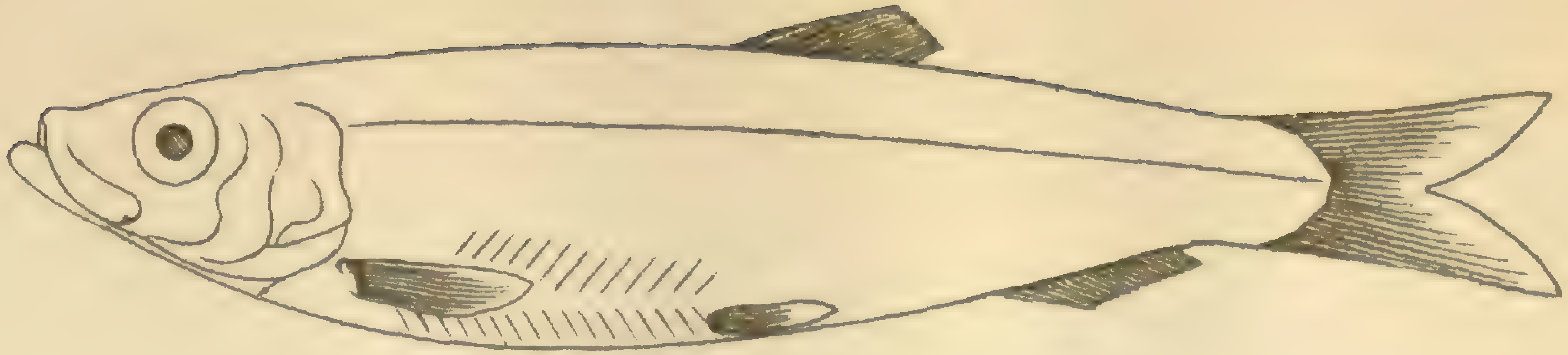
[*Read before the Otago Institute, 30th January*, 1883.]

Plate XXXIV., fig. 2.

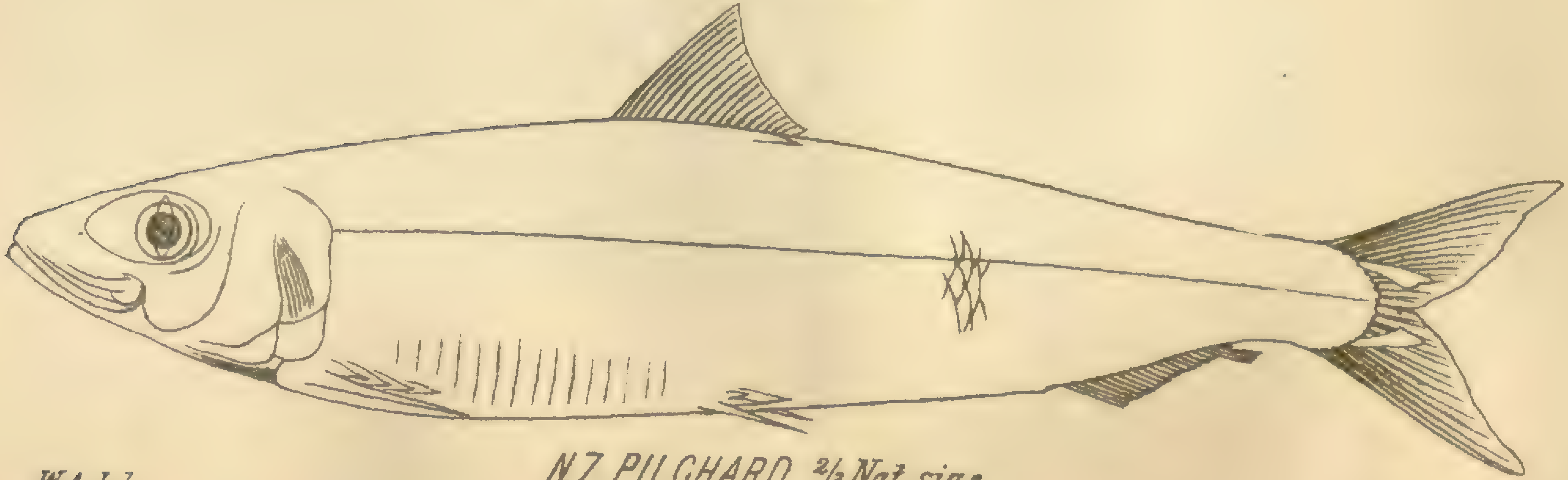
This very interesting and excellent herring, although mentioned in the Catalogue of New Zealand Fishes, has not, so far as I can find, been figured and described from actual specimens.* With the object therefore of supplying this information I obtained recently (September, 1882) from Mr. A. G. Fell, of Picton, five fish newly caught at Picton, and known there as "Picton Herring." Four of these I have examined so far as I am capable of so doing, and with the following results.

Specimen No. 1, plate XXXIV., figure 2, has a gently-curved dorsal outline, abdominal more deeply curved from the head backwards towards the ventral fin. Tolerably thick across the back, and not compressed laterally like the New Zealand sprat. Head one-fifth of total length of fish, triangular in outline laterally and transversely, the ridge of the skull flat, broad, and straight. Maxillary broad, curved, flat, and well rounded

* According to Dr. Günther, New Zealand specimens are in the British Museum. *Clupea sagax*, Jenyns, was also identified from Otago specimens, and a figure of it reproduced in the Cat. N.Z. Fishes, p. 119, pl. e. The same species was subsequently identified as the true Picton herring of commerce, of which the first-received specimens were the *aua* or herring-mullet (l. c. p. 114). *C. sagax* is the common pilchard of the Pacific, and is abundant on the Australian coasts under the name of *maray*. An interesting account of its migrations is given by the Hon. W. McLeay, F.L.S., in the report of the Fisheries Commission of New South Wales.—Ed.



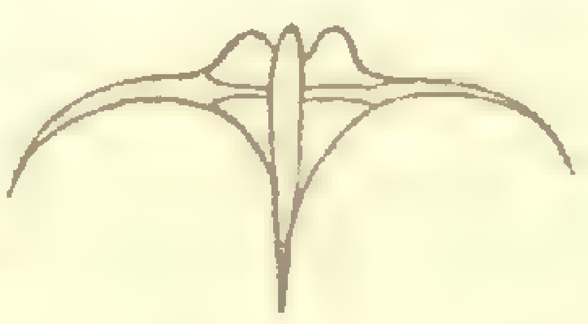
N. Z. SPRAT, Nat: size.



W. A. del.

N. Z. PILCHARD, ⅔ Nat. size.

at posterior end, which reaches slightly beyond vertical line drawn from anterior margin of orbit. Mandible projects a little beyond intermaxillary. Mouth, when fully open, has a gape of three-quarters to an inch. Opercula all well defined, posterior margin nearly vertical and straight, five or six distinct striæ on preoperculum pointing to base of pectoral fin. Diameter of eye one-fifth length of head, pupil black, iris olive-yellow. This organ—the eye—is sunk with orbit about one-eighth of an inch (or below the plane of the cheek), and is protected by a beautifully-transparent disc of apparently thickened skin, convex in form, extending half an inch in front of centre of eye and three-tenths of an inch behind the same point, and provided with a slit or opening directly over the centre of eye vertical in position and gibbous in form or spindle-shaped. This disc is evidently meant to protect the eye, and, at the same time, to compensate for the diminution in the range of vision caused by the eye being sunk in the head. Fins small and delicate in structure, rays mostly soft or branched. One dorsal fin only, situated exactly midway between snout and origin of middle or shortest rays in tail-fin, fourth ray longest. Ventral fin origin, in vertical line from eighth or middle ray of dorsal fin; tail-fin deeply forked, nearly bifurcate. The posterior end of the anal fin is distinguished by a few long feathered rays much longer than those adjoining them in body of fin. The scales are large, irregularly rounded, transparent, and on exterior margin pectinate, also very tough, and not deciduous. Along the base of or parallel to base of the dorsal, pectoral, and ventral fins, rows of scales are situated differing in form from the body-scales of the fish, but resembling in shape those fins beside which they grow; and on each lobe of the caudal fin on both sides are scales or skin-like plates, somewhat like the respective lobes they are attached to. The other or body scales, besides possessing the shape described above, are arranged in layers which overlap each other so as to leave a diamond pattern over the surface of the trunk of the fish. As in the pilchard of the English channel, described by Yarrell, a series of three-limbed scales, or rather dermo-hæmal plates or processes (for they are bony) exist along the outline of abdomen from the pectoral to the anal fin. These are as figured, are buried underneath the true scales, they diminish in size towards the tail, overlap each other, and are placed with short end of mid portion pointing towards the tail. Looked at transversely they conform to the precise outline of that part of the hæmal arch here situated, viz., the bottom. No lateral line visible on this specimen. *In colour*, indigo blue on back and head, shading off into grey on sides, and silvery white on belly, general aspect of body very silvery. There are seven or



eight dark spots alongside, not very well defined, and many minute spots about mouth and shoulders. The scales under certain lights show a beautiful sheen or nacreous lustre as in the true British herring, the sides of head the same. Dorsal and caudal fins dusky, other fins white in colour.

Dimensions.—Weight, 5 oz.; total length, 10 in.; D. $1\frac{8}{10}$; G. $4\frac{1}{2}$; l. d. of T., $\frac{6}{10}$; head, $2\frac{1}{10}$ in.

Fin rays.—D, 17 or 15^2; P, 17; V, 8; A, 17; C, $19\frac{3}{3}$; Branch. r. 7. Lengths—D, $1\frac{2}{10}$ in.; P, $1\frac{1}{10}$; V, $\frac{8}{10}$; A, $1\frac{3}{20}$; C, $1\frac{5}{10}$ longest ray, $\frac{2}{10}$ shortest ray, $1\frac{9}{10}$ spread.

Teeth.—None perceptible to the touch.

Scales.—Lat. l. 60; trans. l. 12, large and lustrous. Vert. and Pyl. c. not taken to avoid cutting up of specimen.

Specimen No. 2.

In external form and colouring this and the two following pilchards are exactly similar to No. 1 above described.

Dimensions.—W. $5\frac{1}{2}$ oz.; L. $9\frac{3}{4}$ in.; D. $1\frac{8}{10}$; G. $4\frac{3}{4}$; l. d. of T., $\frac{13}{20}$; eye, $\frac{4}{10}$; head, 2.

Fin rays.—D, 16^2; P, 18; V, 8; A, 17; C, $19\frac{3}{3}$; B, 7; Vertb., 49. Lengths—D, $1\frac{2}{10}$; P, $1\frac{3}{10}$; V, $\frac{7}{10}$; A, 1; C, spread 2 in.

Teeth.—None perceptible to touch on mouth or tongue, but a slight roughness on mandible.

Contents of stomach.—Stomach siphon-shaped, and containing a large quantity of brown minute granules. Coating of stomach arranged in narrow parallel ridges of fine texture, and of a dark pink colour. Sac or thin covering (duodenum) also full of granules. Intestine long, curved, and full of darker substance like granules. Air-bladder silvery, other viscera too much decayed for examination.

Specimen No. 3.

Dimensions.—W. $3\frac{3}{4}$ oz.; L. $9\frac{3}{10}$; D. $1\frac{3}{10}$; G. $4\frac{1}{4}$; l. d. of T., $\frac{6}{10}$; head, 2; eye, $\frac{4}{10}$.

Fin rays.—D, 17 or 15^2; P, 17; V, 8; A, 17; C, $19\frac{3}{3}$; B, 7; Vertb., 48. Lengths—D, 1 in.; P, $1\frac{4}{10}$; V, $\frac{7}{10}$; A, 1; C, spread $1\frac{9}{10}$.

Teeth.—None perceptible to touch, but slight roughness on mandible.

Contents of stomach.—Same as in previous specimen. Air-bladder silvery. Pyl. cæc., 100.

Specimen No. 4.

Dimensions.—W. 3 oz.; L. 9 in.; D. $1\frac{5}{10}$; G. 4; l. d. of T., $\frac{11}{20}$; head, 2; eye, $\frac{4}{10}$.

Fin rays.—D, 17 or 15^2; P, 16; V, 8; A, 19; C, $19\frac{3}{3}$; Branch., r. 7. Lengths—D, 1 in.; P, $1\frac{3}{10}$; V, $\frac{7}{10}$; A, $\frac{9}{10}$; C, spread $1\frac{9}{10}$. Vertb., 43, but doubtful as bones got separated after boiling.

Teeth.—None perceptible to touch, but mandible rough.

Contents of stomach.—Mass of brown granules same as in No. 2 and 3. Air-bladder silvery. Pyl. cæc., 69, but so much decayed as to be doubtful.

In April last, a fish caught at Otago Heads was given by Mr. Jewit, fishmonger, Dunedin, to Mr. Hugh Maclean, who, on having it cooked and eaten, was of opinion that it was a real herring. I did not see it, and it is impossible now to decide its species, only that I understand the fishmonger called it a Picton herring, which it probably was. However, on the 20th November, 1882, I got possession of an undoubted Picton herring from Mr. Maclean, and which had been taken in Otago Harbour; and the following is a description of it:—

In *form*, fusiform, dorsal outline nearly straight, belly curved from mouth to ventral fin deeply; head triangular in profile and transversely, interorbital space straight, broad and flat; fine striæ on operculum pointing to origin of pectoral fin, opercula same as in above specimens; mouth small and opening to three-quarters of an inch; maxillary fine, curved and with circular end; mandible projects slightly; eye $\frac{6}{20}$ inch in diameter and situated close to ridge or interorbital space, pupil blue, iris yellow, depressed in cavity of orbit, transparent covering disc same as in specimen No. 1., only the opening or slit was much wider being equal to half diameter of eye. Fins fine, clear and delicately formed, dorsal and pectoral finely pointed; origin of ventral at vertical from base of eighth dorsal ray; caudal or tail-fin very much forked and having four scales as in above examples. No serrature of abdominal outline, but bony scales present or dermo-hæmal processes under true scales as figured above, overlapping and having short end pointing tailwise from pectoral to anal fin. No lateral line visible, but eight distinct bands parallel to axis of fish from gill openings to base of caudal, blue in colour along back and more or less distinctly spotted with marks of an indigo hue; those towards the belly lighter and greenish in colour, but without spots. In *colour*, back an indigo, sides and belly white, but the whole with a covering of silvery scales, nacreous under certain lights.

Dimensions.—W. $2\frac{1}{2}$ oz.; L. $8\frac{1}{10}$ in.; D. $1\frac{4}{10}$; G. $3\frac{6}{10}$; l. d. of T., $\frac{5}{10}$; head, $1\frac{6}{10}$.

Fin rays.—D, 18 or 16^2; P, 17; V, 8; A, 17; C, 19; Br., 7. Lengths—D, $1\frac{1}{10}$; P, 1; V, $\frac{6}{10}$; A, $\frac{9}{10}$; C, long ray, $1\frac{3}{10}$, s.r., $\frac{3}{10}$, spread, $1\frac{9}{10}$.

Teeth.—None perceptible to touch about the mouth anywhere.

Scales.—Lat. l. 60; trans. l. 12; large and irregularly rounded, overlapping.

Vert.—36, but incomplete owing to some getting astray before examination, and so lost.

Contents of Stomach.—Walls of abdominal cavity black in colour. Stomach siphonal, and containing mass of brown granules. Intestine full of olive-coloured softer matter. Pyl. cæc., 59; but, as these are small and delicate, and I used considerable pressure with back of knife in removing fatty matters to facilitate counting, I may possibly have removed a number without being aware of it. When cooked this pilchard was most excellent to eat. In several *smoked specimens* of this fish as sold in the Dunedin market I found, so far as possible to make them out, all the marks correspond with those of fresh specimens above described. Form of the head and gill-covers, striæ, position of ventral fin, fin-rays, all agree—the vertebræ in two examples numbering 50 each; but outline of abdomen was distinctly serrated or marked by raised scales, due probably to projection of dermo-hæmal plates after curing.

A comparison of our New Zealand pilchard or Picton herring with Yarrell's account of the English form shows such a close relationship as almost amounts to identity of species. It is also very interesting to notice how well designed certain parts are to fulfil their special functions, as the transparent jelly-like disc or covering for the eye. The eye being well sunk in the orbit beneath the plane of the cheek its range of vision would be very limited were the orbit not likewise sunk. This being so it is also necessary that the surrounding orbital bones should be gradually curved in to the depressed eye. This secures range, provision for which over the ante-orbital bone is greater than over post-orbital, showing that the fish needs to see more ahead than behind. Then covering the eye is the disc I have mentioned, protecting the eye from injury, while it permits free vision by its transparency, with direct vision in front of fish by refraction, and by its form and bulk giving symmetry and completeness to the adjoining parts. From the difference in width of openings or slits between the first set of fish examined and the last one, I should expect that these fish have the power of opening and closing the slit at pleasure.

I have stated that the scales are tough and non-deciduous, and may add that they are so wonderfully overlapped and wedged together as to form an outer covering or coat of mail completely surrounding the trunk of the fish. This protection is a very obvious part of the design, for the bones of the skeleton are extremely fine and seem unequal (unassisted) to carrying the fleshy parts of the body. The abdomen in particular is a most delicate part, and was more or less injured in the fresh specimens examined by me, a characteristic which I found extending to the viscera also, to the prevention of my searches in that direction to some extent. And here again the perfection of design appears, for along the abdominal outline where the

hæmal arch is weakest, it has completeness and strength given to it both longitudinally and transversely by those locked and overlapping bony scales or plates which I call dermo-hæmal processes.

As to the *habits* of the Picton herring, I am also indebted to Mr. Fell for collecting for me the following particulars:—"The fish is found all round Queen Charlotte Sound, and also the adjoining Pelorus, but is only caught here (Picton). Generally it is believed that they do not extend outside, but my half-caste fisherman maintains that if sought for properly they would be found all round Nelson waters (Blind Bay) and in the straits. They are not easy fish to find, unless they are rushing on the surface, which is not often, and is a most peculiar sight. My own idea is that they will be found to extend much further to the south, but not into the warmer water north. These herrings are in Queen Charlotte Sound during the whole year, but only come into the shallow bays during winter. At that time of the year they keep together in large shoals, but in summer time they keep more apart, and are sometimes caught then, though rather hard to find. No systematic fishing goes on during summer. The fish prefer colder water, and thus leave the shallow bays when spring sets in.

"They spawn during summer, are always very full of roe about Christmas time, and then keep in small shoals.

"As to the probable numbers visiting the Sound it is difficult to say, but four smoke-houses were kept going all last winter. The hauls made average one and a half to two tons, but at times ten tons have been landed.

"As an article of food it is, when fresh, exceedingly good fried. The same fish smoked is sold as Picton herring. The fishermen here have very poor appliances and are not skilled at all in curing, and I am sure the system is capable of improvement."

ART. XXIV.—*On two new Planarians from Auckland Harbour.*

By T. F. CHEESEMAN, F.L.S.

[*Read before the Auckland Institute, 27th September*, 1882.]

1. *Thysanozoon aucklandica*, n. sp.

Body thin, depressed; margin ample, with numerous irregular folds and puckers. Upper surface wholly covered with large mobile clavate papillæ. Colour varying from dark ashy-brown to light grey, marbled or shaded with paler streaks, sometimes reddish-brown; under-surface an opaque greyish-white, the gastro-vascular canals showing through of a chalky-white colour. Head indistinct. Tentacles two, formed by mere folds of the anterior margin of the body. Eye-specks about 75, forming a crescentic patch in

an open space between the tentacles, or sometimes broken up into two separate patches. The colour of the papillæ is usually a dark grey or brown with two or three opaque white specks. Length, 1–2 inches; breadth, ½–1 inch.

Common under stones near low-water mark in Auckland Harbour.

2. *Leptoplana* (?) *brunnea*, n. sp.

Body oblong, thin, flat, depressed, smooth, and even; margin ample, entire. Colour of the upper surface a chocolate- or reddish-brown, sprinkled and streaked with minute darker specks; under surface much paler, the dendritic gastro-vascular canals showing through. No distinct head or tentacles. Eye-specks very numerous, minute, placed in a row just within the margin all round the anterior portion of the body. Total length, 1–2 inches; breadth, ½–1 inch.

Common under stones in muddy places in Auckland Harbour.

The position of the eye-specks does not at all agree with Stimpson's definition of *Leptoplana* given in the Proceedings of the Academy of Sciences, Philadelphia, 1857, p. 21; but at present I do not know a better genus in which to place it.

Art. XXV.—*Notes on a Skeleton of* Megaptera lalandii (novæ-zealandiæ), Gray. By Prof. Julius von Haast, Ph.D., F.R.S.

[Read before the Philosophical Institute of Canterbury, 6th April, 1882.]

The Canterbury Museum possesses a skeleton of this whale, caught on May 6th, 1875, in Akaroa Harbour. The animal, a female, was accompanied by her calf. This was also killed, but unfortunately I heard of it too late for recovering its skeleton. Hitherto, as far as I am aware, no complete skeleton of this species had been obtained in New Zealand, although considerable portions of it are preserved in several museums in the Colony. The New Zealand species was established by the late Dr. Gray from an earbone alone; but Dr. Hector, after having compared the skull of our *Megaptera* with that of the Cape of Good Hope in the Paris Museum, states that the animals belong both to the same species.* With this conclusion I fully agree, because, after comparing carefully the different parts of the Canterbury Museum specimen, with those described and figured in the Ostéographie des Cétacées by Van Beneden and Gervais, no distinctive features of sufficient importance could be found to separate the New Zealannd humpback whale from that occurring at the Cape. As the specimen under review had already been cut up before I became aware of its capture,

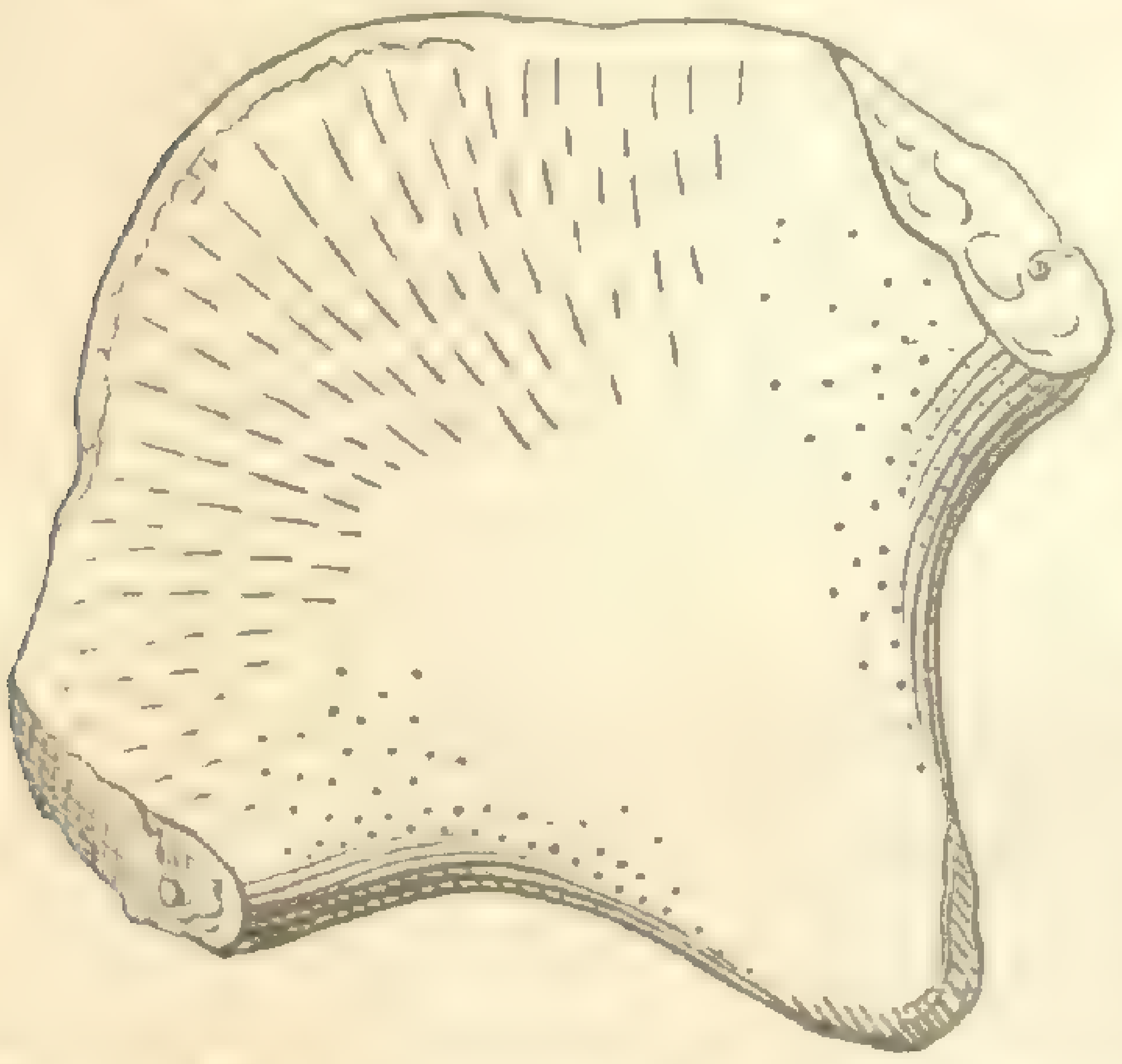
* Trans. N.Z. Inst., vol. x., p. 336.

no measurement of the animal in the flesh could be taken. Allowing for the intercartilage of the vertebræ, the animal had probably a total length of 30 feet. The skull measures 7 feet 8 inches in length, with a greatest width across the ossa zygomatica of 5 feet.

The animal was evidently a young one, all the plates of the vertebræ and the epiphyses of both extremities of the pectoral limb being still unanchylosed. I counted 318 plates of baleen on each side of the jaw.

It is short, has the usual falcate form, is of a uniform black colour, and is edged with thick bristles. Beginning at the gape it increases rapidly in size, so that the sixtieth plate is 4¾ inches broad at the base, and 13½ inches long, with a length of the bristles at the tip of 2 inches. This size it maintains for about 150 plates till to the hundredth plate from the snout, when it begins to diminish in size, so that at the sixtieth plate it is only 10 inches high and 3¾ inches broad at the base. It still continues to become gradually smaller till the twentieth plate is reached, when it rapidly decreases in size. The number of vertebræ of which the 7 cervical are all free is—7 cervical, 13 dorsal, 10 lumbar, 21 caudal: total 51. We possess, however, 19 caudal vertebræ only, the two last, and, according to my informant, very small vertebræ having been lost during the transmission of the skeleton. There are only 13 dorsal vertebræ instead of 14, as usually occurring in them, but I am certain that one pair of ribs is neither wanting nor could I find any articulation on the twenty-first or first lumbar vertebra, which in every respect resembled the following or second lumbar. Van Beneden and Gervais, on page 127 of their "Ostéographie des Cétacées," state, when speaking of the northern humpback, *Megaptera boops*, "Il y a des squelettes à treize côtes, mais l'on peut supposer, qu'il y a une qui manque." In view of the occurrence of a similar deficiency in the humpback of the southern hemisphere where according to the same authors the number of the dorsal vertebræ is 14, the same as in *M. boops*, we have to admit that the number varies between 13 and 14. The number of lumbar vertebræ is given as 9. However, I failed to find in the tenth or following vertebra, which ought to be taken as the first caudal, any sign of a hypapophysis for the articulation of the first chevron bone; it resembled in this respect entirely the foregoing ninth lumbar. The space for this articulation in the next or eleventh vertebra is marked so very slightly, that I once thought it might also be added to the lumbars. In that case there would have been 11 lumbars and 20 caudal vertebræ. Lilljeborg in his exhaustive memoir on the Scandinavian Cetacea published by the Ray Society amongst the memoirs on the Cetacea, states that *Megaptera boops* has 11 lumbo-sacral and 21 caudal vertebræ. He has probably experienced the same difficulty as I had to distinguish

between the last lumbar and first caudal. It may, however, be possible that the first chevron bones are so very rudimentary that they were not secured at the time, in both instances, and that moreover they do not articulate with the posterior lower surface of the vertebra in question. Van Beneden and Gervais state that the spinal processes augment in height along the vertebral column to the first lumbar vertebra in *M. boops*. No information is offered on this point in their description of the skeleton of *M. lalandii*. I found in the New Zealand specimen that the spinal processes continue rising up to the third lumbar, which is 11⅜ inches high, the first being 10¾ inches and the second 11 inches.



The sternum, a rather thickish bone, is 9¼ inches high and 9 inches broad. It is rounded at the top and pointed below. One well-marked articulation exists on each side for the attachment of the rib. I have added a drawing (the inner side of the bone) in illustration.

The sternum of *Megaptera* on pl. ix. of Van Beneden's and Gervais' work varies very much from ours, as it is more in the form of a horseshoe, with its frontal part downwards, so that the open side is at the top.

The scapula, of which a correct drawing of that of the left side also accompanies these notes, measures 29½ inches in breadth by 21½ inches in height. It does not possess the character of the scapula figured by Van Beneden and Gervais on page 133 of their previously-cited work, where a well-marked acromion is existing.

Our specimen, although not totally devoid of this character in the northern *Megaptera*, shows this only in a very rudimentary degree. The spot whence the acromion starts in the *Balænidæ* is only very slightly swollen, so that a small curve is marked on the outline of the bone. There is no sign of a coracoid.

The drawing of the scapula on plate ix. of the atlas belonging to the same work is however more in accordance with the bone of the New Zealand specimen.

ART. XXVI.—*Description of a new Species of* Æolis. By T. W. KIRK, Assistant in the Colonial Museum.

[*Read before the Wellington Philosophical Society, 9th December,* 1882.]

THE beautiful little animal described below was collected at Napier by Mr. A. Hamilton, of Petane. Mr. Hamilton kindly forwarded specimens both in glycerine and spirit, so that the bright colourings are to a large extent preserved. I am also indebted to him for notes of colours, etc., taken from living specimens. The accompanying figures of the animal are natural size.

Æolis, *Cuv.*

Animal ovate; dorsal tentacles smooth, oval, slender; papillæ simple, cylindrical, numerous, depressed, and imbricated; mouth with a horny upper jaw, consisting of two lateral plates united above by a ligament; foot narrow; tongue with a single series of curved, pectinated teeth; spawn of numerous waved coils.

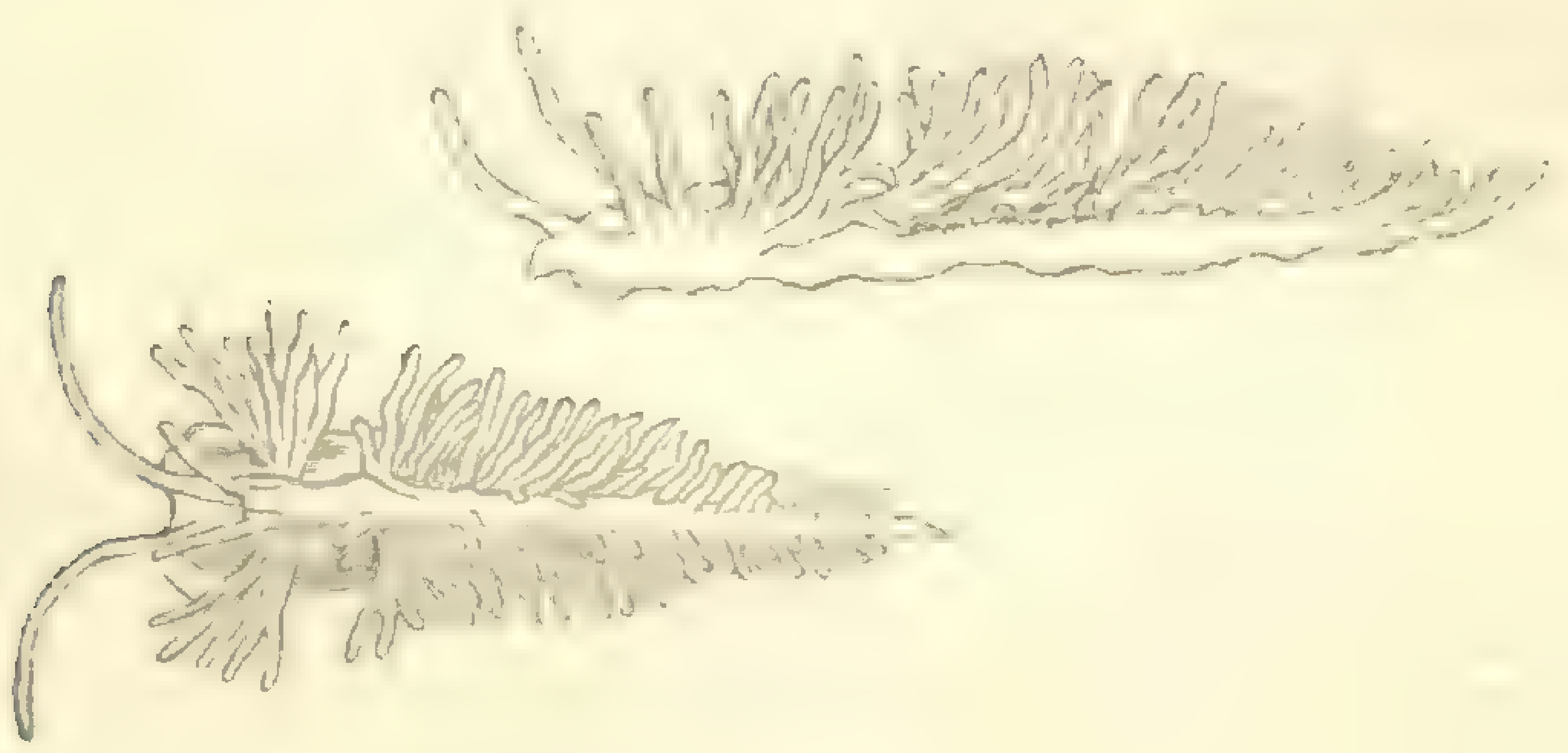
Æolis gracilis, sp. nov.

Body small; tail sharply pointed. Gills as long as greatest width of the body, papillose, crowded, but placed in three tolerably distinct groups on each side of a broad clear line running from the base of the tentacles to the tip of the tail; oral tentacles subulate, rather distant, about twice as long as the greatest width of the animal. Tentacles approximate, about half as long as the oral tentacles. Foot expanded, produced in front, margin thin, slightly puckered.

Colour—body and foot pale pink; tentacles and gills bright red prominently tipped with white.

Length, ·9 of an inch.

Hab.—On *Ulva*, Napier (collected by Mr. A. Hamilton).



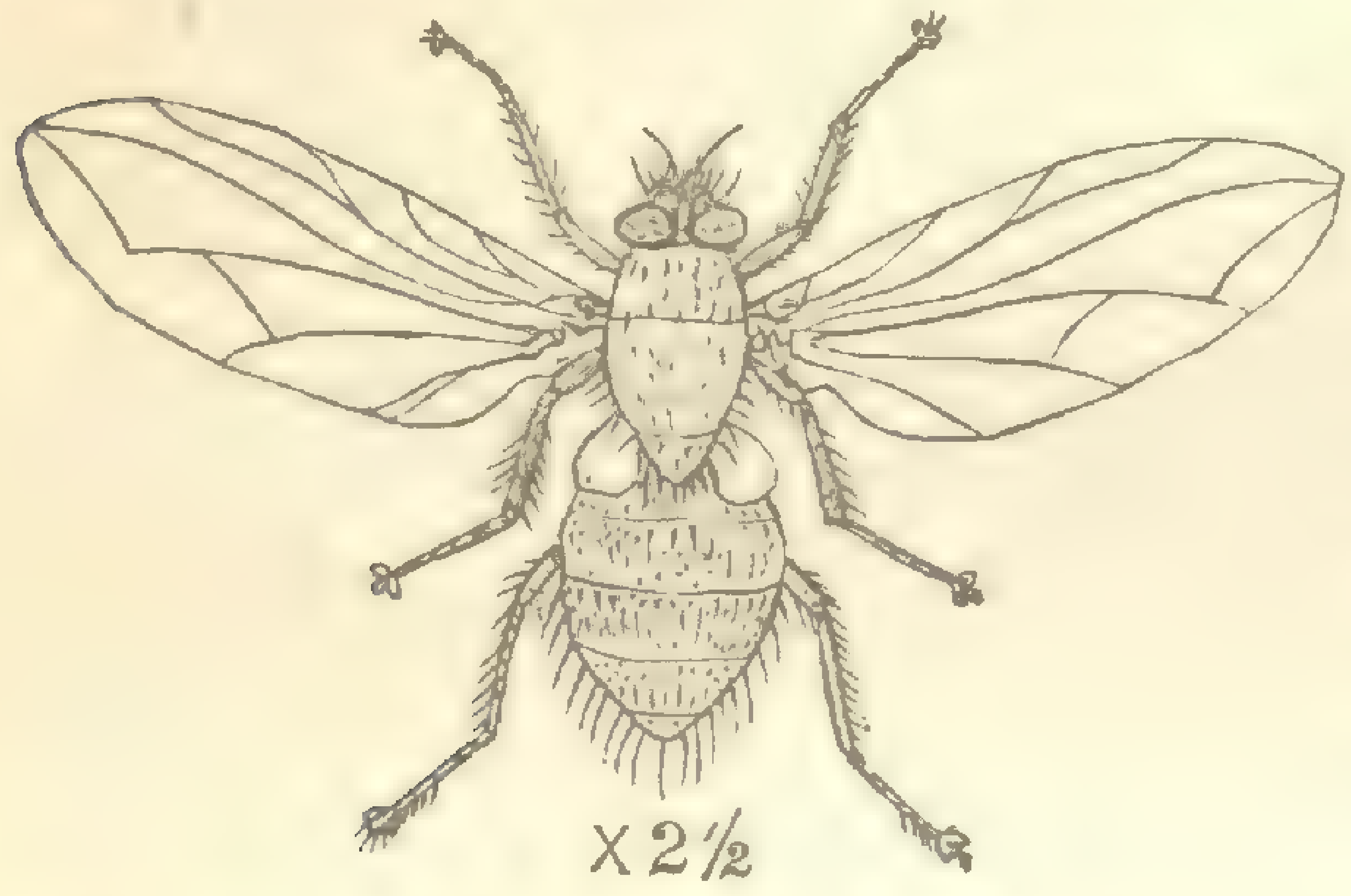
Art. XXVII.—*Description of a new Dipterous Insect.* By G. Vernon Hudson. Communicated by T. W. Kirk.

[*Read before the Wellington Philosophical Society, 9th December*, 1882.]

This species is parasitic in the common magpie moth (*Nyctmera annulata*); it makes its way out of the insect when in pupa by boring a hole in the hard shell before turning; the pupa of the fly is dark-brown, with scarcely any trace of articulations; it remains in that state about six weeks.

Nemoræa nyctmerianus, sp. nov.

Body black with numerous black hairs and bristles; head with a broad longitudinal furrow between the ocelli extending downwards towards the base of the antennæ, covered sparingly all over with black bristles. Eyes, reddish-brown, with a slight golden pubescence. Proboscis black, slender, covered at the tip with tawny bristles; palpi deep black, with one or two short hairs. Antennæ less than three-fourths the length of the face, jet-black throughout, destitute of hairs, third joint about twice the length of the first and second together. Style black. Thorax dull black, with many long black bristles round the sides and beneath. Scutellum dull ferruginous, darker towards the mesonotum, armed with several long spines at the sides. Abdomen oval, broader than the thorax and about as long, black with faint bluish reflections; along the anterior margin of the segments there are indistinct grey bands, which are crossed by a similar one running down the middle of the abdomen, the whole of which is covered with shallow black punctures, out of which short hairs rise; long bristles are present on the posterior margins of the abdominal segments in the centre and sparingly on the sides, becoming very numerous towards the apex. Legs rather long and slender, black, the tibiæ fuscous, clothed with short bristles; foot-cushions small, light-brown. Wings hyaline, clouded with tawny towards the base; ribs black, becoming brownish towards the base. Scales pearly-white, subopaque.



Length, 3 lines. Expanse of wings, 5½ lines.

ART. XXVIII.—*On the Gravid Uterus of* Mustelus antarcticus.

By T. JEFFERY PARKER, B.Sc.

[*Read before the Otago Institute, 31st October*, 1882.]

Plate XXX.

THE viviparous dog-fish *Mustelus* is remarkable for the fact that in one of its species, *M. levis* of the northern seas, a vascular connection is established between the fœtus and the mother by the yolk-sac of the former entering into close contact with the wall of the uterus, and thus forming an "umbilical placenta." This arrangement becomes all the more remarkable from the circumstance that in the other species of the genus no such connection obtains.

In Günther's "Catalogue of Fishes," as well as in his more recent work, "The Study of Fishes," the common southern *Mustelus*, *M. antarcticus*, is merely said to be, like *M. vulgaris* and other northern forms, devoid of an umbilical placenta, from which one would naturally expect to find the fœtuses lying freely in the uterine cavity, as in other viviparous sharks—e.g., *Scymnus* or *Acanthias*. I was therefore considerably surprised to find, on dissecting a gravid female of *M. antarcticus* a week or two since, that the relations between the mother and the fœtus were nothing like so simple as I had expected, but that, just as the *Mustelus levis* furnishes a sort of foreshadowing of the true placenta of mammals, so *M. antarcticus* is provided with membranes which, although formed from the maternal and not from the fœtal tissues, foreshadow in a remarkable manner the chorion and the amnion.

The specimen referred to, and others dissected subsequently, were evidently near delivery, since the fœtuses (see fig. 1) were large and perfectly formed, and their yolk-sacs (*yk. s*) were reduced to the size of a small pea. On opening the abdomen the uteri were at once noticeable from their great transparency and extreme tenseness: the fœtuses could be plainly seen through their walls, and the uteri themselves had the appearance of being distended with fluid. By squeezing the uterus from the outside each fœtus could be only very slightly displaced; it was evident that they were confined in some way, but not by actual attachment to the uterus.

The explanation of these appearances was at once evident on opening the uterus. Each fœtus was then seen to be enclosed in a separate compartment, filled with a colourless fluid, in which it floated freely. The partition walls between adjacent compartments are evidently quite impervious, so that there was no communication between them, nor between the anterior compartment and the cavity of the Fallopian tube (fig. 1, *f.l.t.*) or the posterior compartment and the cloaca.

Each fœtus lay coiled up in its compartment (fig. 1), some part of its body, in many cases, pushing one of the partition walls and causing it to bulge out into the adjacent compartment. In the specimen figured, for instance, the head of fœtus H encroaches upon compartment G; the trunk of G encroaches upon compartment H, and its head upon F. The fœtuses are thus packed as closely as if they were not enclosed in separate chambers.

In the specimen figured there were eight fœtuses in the uterus, but the usual number seems to be five. In some cases one fœtus was considerably less developed than the rest: this is the case with A in fig. 1: in one instance there was in the anterior end of the oviduct a mass of yolk, evidently an egg which had undergone no development.

The precise anatomical relations are as follows:—The wall of the uterus, as mentioned above, is very thin: it consists of an outer peritoneal investment (fig. 2, *p*), then of a remarkably thin muscular layer (*m*), and finally of the mucous membrane (*m.m.*). The latter is produced into a series of reduplications which extend across the cavity to the opposite wall, and in this way the fœtal compartments are formed.

From this it is evident that the outer walls of the fœtal compartments are simply portions of the uterine walls, and are lined with epithelium, but that the party walls (*ps. ch.*) consist of mucous membrane only, covered with epithelium on both sides. The mucous membrane has a yellowish colour, is raised on its free surface into numerous folds, and is abundantly supplied with blood-vessels, so that each fœtus is surrounded with a vascular membrane.

From the inner surface of the mucous membrane, a thin colourless transparent non-vascular layer (fig. 2, *ps. am.*) can be readily dissected off. From the relations of the mucous membrane, as just described, it follows that this non-vascular membrane must occur in the form of a series of closed sacs, forming the actual lining of the several compartments.

As a consequence of this arrangement, when the peritoneal and muscular layers of the uterus are stripped off—which can be done with great ease—and the Fallopian tube and cloacal end of the uterus removed, the mucous membrane of the uterus proper is obtained in the form of a single perfectly closed sac, but on removing the mucous membrane itself, a number of closed sacs are obtained, each enclosing a fœtus with the surrounding fluid, and consisting of the non-vascular membrane just described.

It will be seen at once that the transparent non-vascular sac in which each fœtus is directly enclosed, has the same general relation to the fœtus as the amnion of Sauropsida and Mammalia, from which it differs in being a product, not of the fœtal but of the maternal tissues. I propose, there-

Fig. 1.

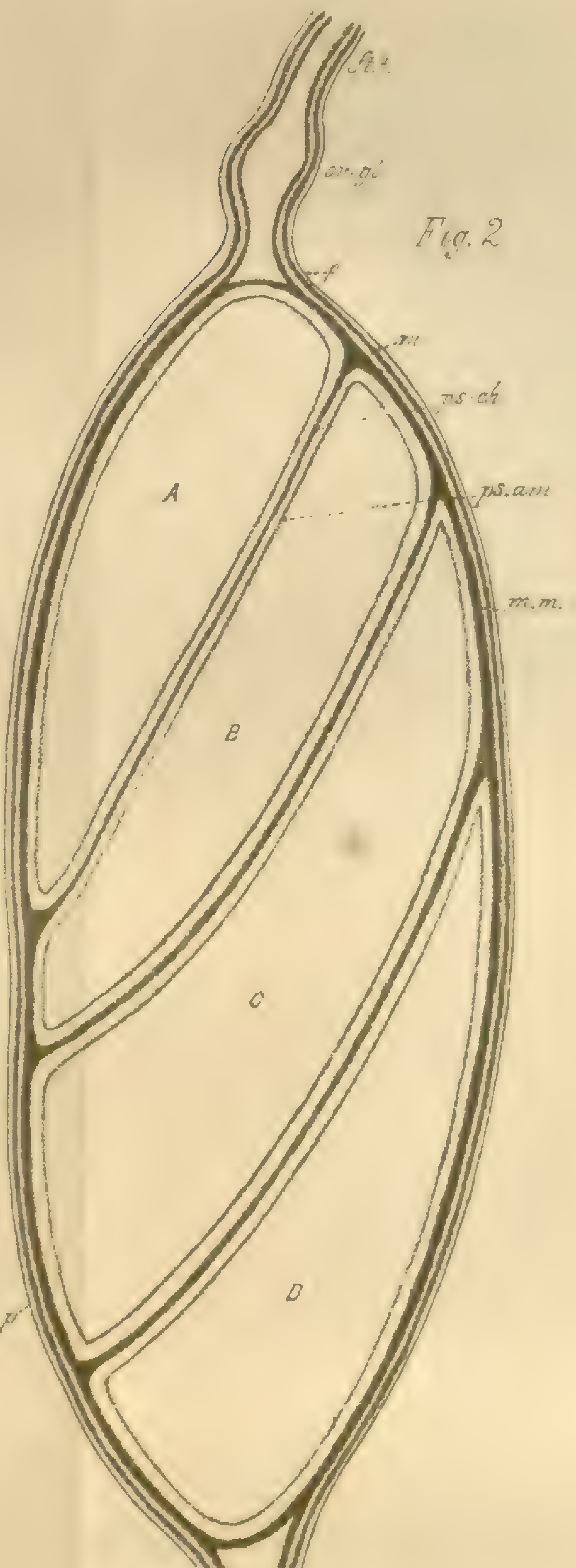


Fig. 2

MUSTELUS ANTARCTICUS.

fore, to call it the *pseud-amnion*.* The fluid it contains and in which the fœtus floats is evidently a serous fluid, and, having the same relations to the fœtus as the amniotic fluid of the higher Vertebrata, may be called the *pseud-amniotic fluid*.

The outer or vasculan layer of each compartment, formed by the mucous membrane proper, contains the blood-vessels from which the fœtus derives its supply of oxygen: it is therefore roughly analogous to the chorion of mammals, and may be called the *pseudo-chorion*.

As regards the histology of the membranes, the most important fact is that the *pseud-amnion* is a true cuticle: it is quite structureless, and is in close contact with the free surface of the mucous membrane, from the epithelium of which it is evidently formed as a cuticular secretion.

As all the specimens I have hitherto examined have been in approximately the same stage of pregnancy, I have been unable to make any observations on the mode of formation of these remarkable membranes: one would be disposed to think, however, from their final disposition, that the investment of each impregnated ovum is formed in much the same way as the human *decidua reflexa*.

The *pseud-amniotic* fluid is colourless, transparent, and very slightly opalescent. Treated with nitric acid, it gives no trace of the xanthoproteic reaction, and may therefore be assumed to contain not more than the merest trace of proteids. Boiled with nitric acid, it gradually assumes a very dark-brown colour. Evaporated to a small bulk and treated with nitric acid, it gives an abundant crop of crystals of *urea nitrata*, so that it must contain a considerable quantity of urea, indicating an active renal secretion on the part of the fœtus. Evaporated to a third of its bulk and treated with hydrochloric acid, it assumes a pink colour, which gradually deepens into dark brownish-red, and deposits a fine pulverulent precipitate of a deep brown colour. Examined under the microscope this deposit shows no trace of uric acid crystal, and appears to consist entirely of fine amorphous granules. I can form no conjecture as to its nature.

From the arrangement of the fœtal membrane of *Mustelus antarcticus*, it is certain that both *pseud-amnion* and *pseudo-chorion* are ruptured at birth, and from this condition at the end of pregnancy, I feel sure that they are entirely thrown off,—in other words that they form a true *decidua*. From the extraordinary thinness of the muscular layer of the uterus, it is certain that it can be of little or no use in the expulsion of the fœtuses: it would seem that they must simply swim into the world, birth being due to the activity not of the mothers but of the offspring.

* There is hardly likely to be any confusion between this pseud-amnion and the so-called "false amnion" of *Amniota*.

EXPLANATION OF PLATE XXX.

Fig. 1. Uterus of *Mustelus antarcticus*, with the several fœtal compartments opened from the ventral side (⅔ nat. size).

A—H, the eight fœtal compartments, with their contained fœtuses.
e.f, partition between compartments E and F, pushed into F by tail of fœtus E.
f.g, partition between F and G, pushed into F by head of G.
g.h, partition between G and H, pushed into G by head of H.
g'.h', partition between G and H, pushed into H by trunk of G.
br, branchial aperture.
c, caudal fin.
d. 1, *d*. 2, first and second dorsal fins.
e, eye.
fl.t, Fallopian tube.
m, mouth.
na, nostril.
pc, pectoral fin.
pv, pelvic fin.
yk.s, yolk-sac.

Fig. 2. Diagrammatic vertical section of the same to show the relations of the fœtal membranes to the uterine walls.

A—D, four fœtal compartments.
fl. t, Fallopian tube.
m, muscular layer.
m. m, mucous membrane.
p, peritoneal investment.
ps. am, pseud-amnion.
ps. ch, pseudo-chorion.

Art. XXIX.—*Notes on the Anatomy and Embryology of* Scymnus lichia.

By T. Jeffery Parker, B.Sc.

[*Read before the Otago Institute, 15th August*, 1882.]

Plates XXXI. and XXXII.

The shark *Scymnus lichia* is stated by Günther* to be confined to the Mediterranean and neighbouring parts of the Atlantic: its range must now, however, be extended to include the South Pacific, since the specimen from which the following notes were made was caught off Pilot Beach, near the Otago Heads, by Coxswain Milne, who immediately sent it, fresh and uninjured, to the museum. It would be of great advantage to zoology if Mr. Milne's example were followed by others enjoying similar opportunities.

Scymnus lichia must, therefore, be added to the list of marine fishes inhabiting both the Northern and the Southern Oceans, a list which includes the porbeagle (*Lamna cornubica*), the piked dog-fish (*Acanthias vulgaris*), the frost-fish (*Lepidopus caudatus*), the John Dory (*Zeus faber*), and several other well-known fishes.

As *Scymnus* has not previously been included in the New Zealand fauna, I will quote Dr. Günther's diagnosis of the family and genus.

* "Catalogue of Fishes," vol. viii., p. 425, and "Study of Fishes," p. 332.

"Family SPINACIDÆ.

"No membrana nictitans: two dorsal fins, no anal: mouth but slightly arched: a long deep straight oblique groove on each side of the mouth: spiracles present: gill openings narrow: pectoral fins not notched at their origin.

"Genus **Scymnus.**

"Two short dorsal fins without spine, the first at a considerable distance from the ventrals; dermal productions uniformly small; nostrils at extremity of snout; upper teeth small, pointed; lower much larger, dilated, erect, triangular, not very numerous: spiracles wide."

Only species, *S. lichia*.

1. *External characters* (fig. 15).

The colour of the specimen is uniform dark brown and has been quite unaltered by the preparation of the skin for stuffing.

The head is flattened and the snout very blunt, with the nostrils (*na*) near but not at its extremity: each nostril is guarded by a cutaneous flap on its inner side. The eyes (*e*) are large, and when fresh were remarkably beautiful, owing to the fact that the pupil was greatly dilated, allowing the silvery tapetum to be seen through the humours, producing a delicate greenish shimmer. There are 19 lower teeth.

The body is markedly constricted a little behind the mouth, producing a sort of imperfect neck; there is then a great increase of girth in the region of the shoulder-girdle, from the pectoral (*pc*) to the pelvic (*pv*) fins the circumference is tolerably uniform.

As to the fins, the small size of the pectorals is noticeable, and the pelvics present a character, apparently not heretofore noticed, which appears to me of some morphological importance. This is a low ridge (*l.r*) extending forwards for some 6 or 8 inches from the anterior border of each pelvic fin, ascending somewhat as it goes. I think there can be no doubt that this is to be looked upon as a retention in the adult of the ridge which, as Balfour has shown, connects the pectoral and pelvic fins in the selachian embryo. On the lateral fin theory of the limbs, this ridge must therefore be considered as a rudimentary structure of considerable interest.

Within the lips of the cloaca is a well-marked pair of abdominal pores (fig. 1, *ab.p*), which communicate with the abdominal cavity. The lateral line (fig. 15, *l.l*) is very obvious.

2. *Alimentary organs.*

The stomach consists, as usual in Selachians, of a wide cardiac portion (fig. 1-3, *cd. st*) of but slightly greater diameter than the gullet, and of a small tubular recurrent pyloric portion (*py. st*); the latter is unusually short, so that the anterior end of the intestine projects but slightly in front

of the posterior end of the stomach, and the whole alimentary canal appears like an almost simple narrow tube greatly exceeded in calibre by the oviducts.

The intestine has a well-marked duodenal section or *bursa Entiana* (*b.e*) into the left lateral wall of which the stomach opens by a small pylorus (*py*) guarded by a well-marked annular pyloric valve. The rest of the intestine is somewhat narrower than the stomach, and of tolerably uniform diameter except at its posterior end, where it narrows considerably before entering the cloaca; with the dorsal wall of this posterior portion or rectum (*r*) is connected the large rectal gland (*r. gl*).

The stomach is supported by a mesogaster attached along the anterior two-thirds of its dorsal side: the intestine is free save for a mesorectum attached to the rectal gland, and to the dorsal wall of the rectum posterior to that structure.

The spiral valve (*sp.v*) is the most perfect apparatus of the kind I have yet examined. It belongs to what I have elsewhere* described as "type C," that is, the width of the valve is greater than the semi-diameter of the gut, and the plane of any part of it is inclined, from its attachment to the intestinal wall, forwards or towards the duodenal end. There are twenty-seven turns to the valve, the total length of the intestine being inches. The muscular wall of the intestine (*w*) is greatly thickened, the thickening being often especially well marked between the turns of the spiral valve. Thus the absorbent surface of the mucous membrane is further increased, an additional obstacle is offered to the passage of the intestinal contents, and great muscular power is obtained for their propulsion towards the cloaca. This great development of the intestinal musculature is an exaggeration of what I described, in the paper just referred to, in *Scyllium canicula*.

The liver (fig. 1, *lr*) is of immense size, its two lobes reaching quite to the posterior end of the abdominal cavity; it weighed 9 lbs. in the fresh state. There is no gall-bladder; the wide bile-duct (figs. 2 and 3, *b. d*) passes from the liver in the gastro-hepatic omentum (fig. 1, *g. h. o*) to the right side of the stomach, and then proceeds directly backwards to open into the anterior wall of the bursa Entiana (fig. 2).

The pancreas (figs. 1 and 2, *pn*) consists of two lobes: one (fig. 2, *pn*) closely applied to the ventral surface of the intestine, just beyond the bursa Entiana; the other (*pn′*) passing backwards and outwards to the left side of the spleen (*spl*), and surrounding the right mesenteric vein (*r.m.v*). The spleen (*spl*) is large, compact, scarcely at all lobulated, and very distensible, swelling to two or three times its orginal size when injected through the arteries.

* On the Intestinal Spiral Valve in the genus Raia," Trans. Zool. Soc., vol. xi., pt. 2, 1880, p. 49.

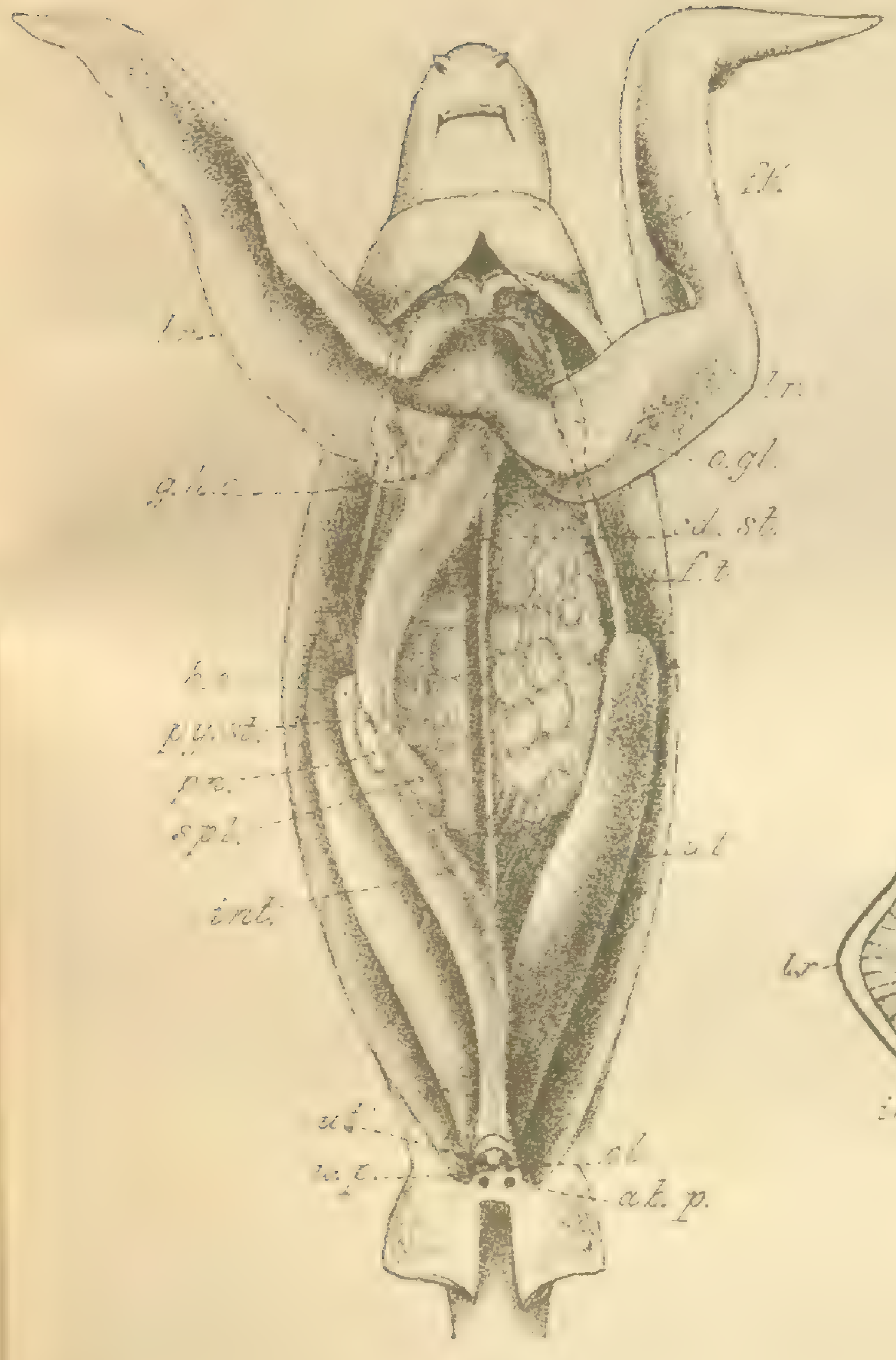


Fig. 1

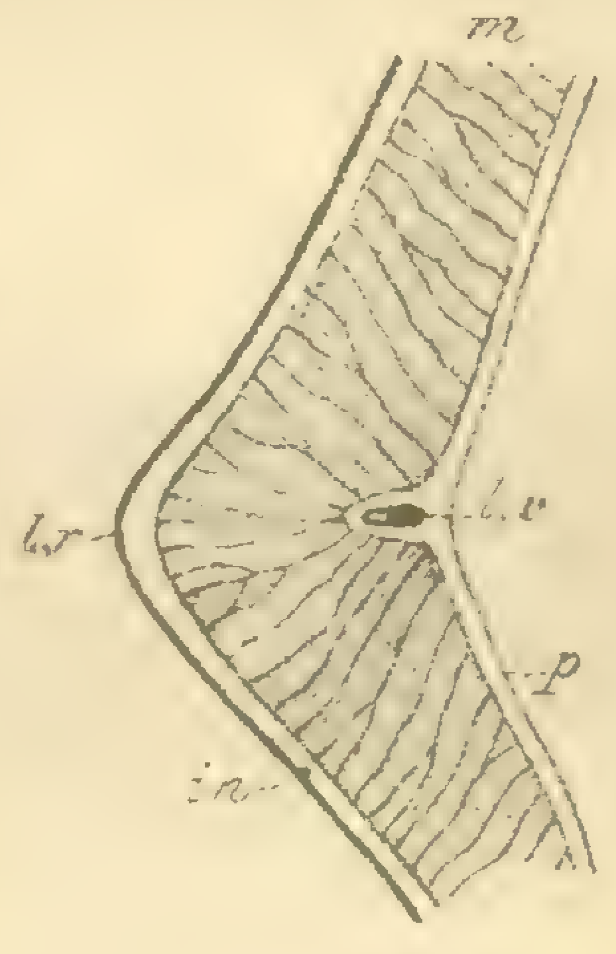


Fig. 4.

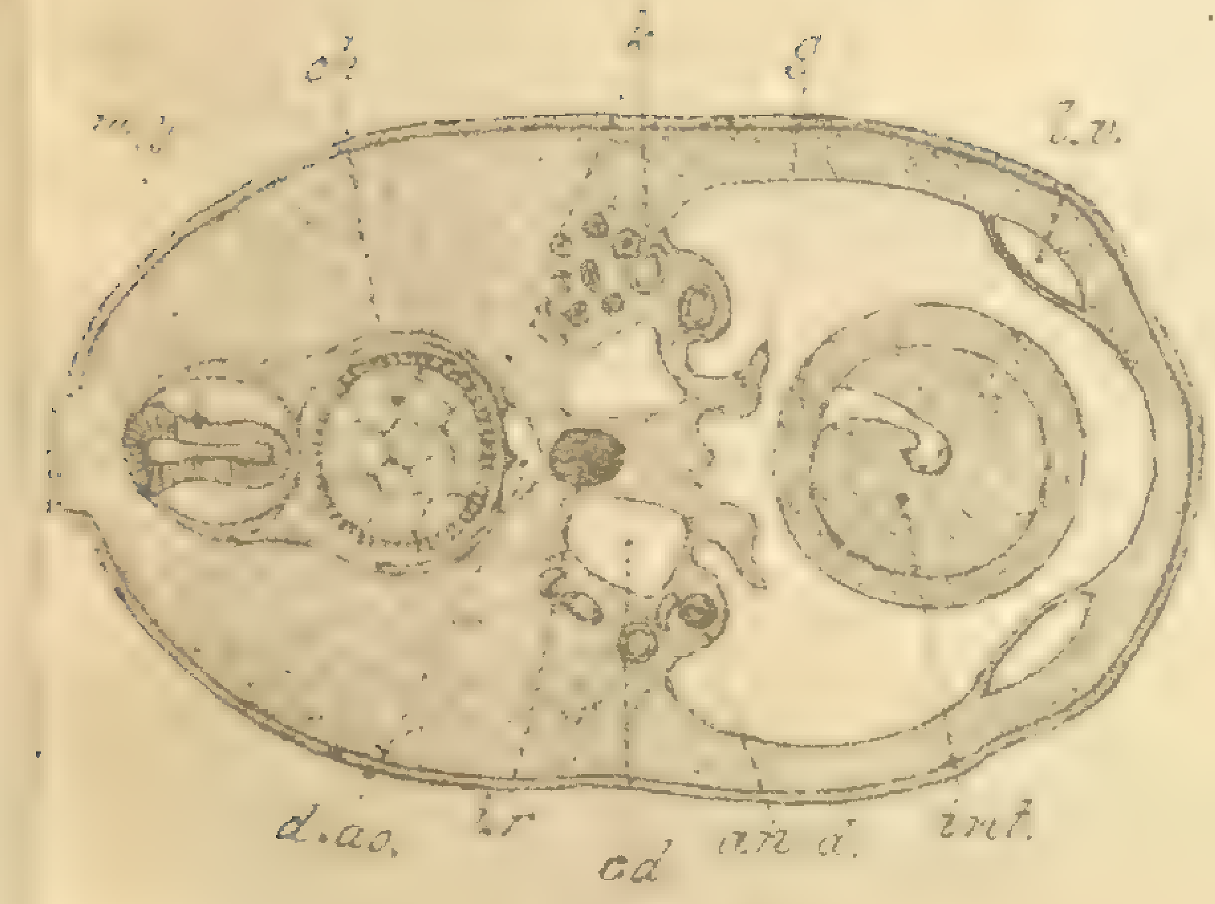


Fig. 5.

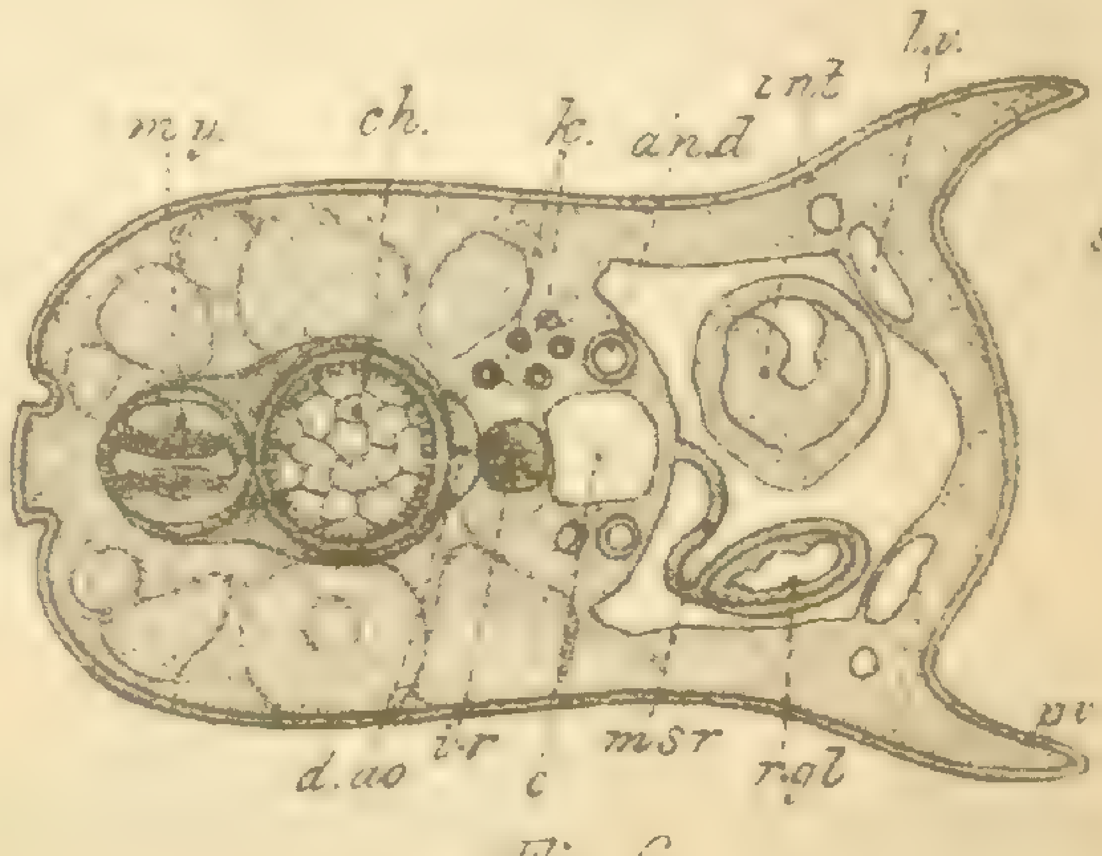
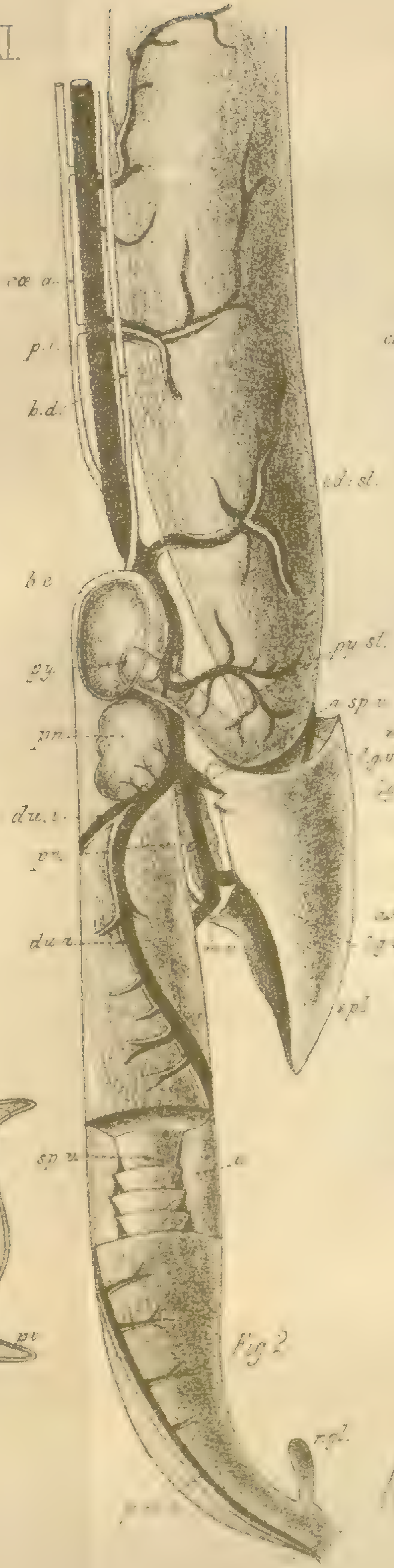
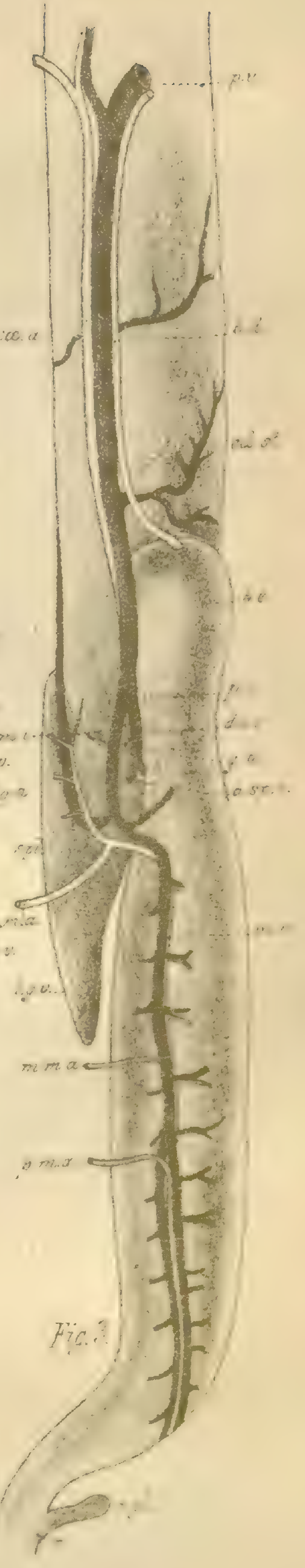


Fig. 6.





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3. *Circulatory organs.*

The heart is comparatively small, not more than half the size of that of a porbeagle (*Lamna cornubica*), a few inches longer than the specimen under consideration; this is probably correlated with the small size of the pectoral fins. Owing to various unfavourable circumstances—the chief of which was the necessity of preserving the skin uninjured for stuffing—I was unable to make a thorough examination of the arteries and veins, and have therefore but few observations to record.

The blood-supply of the alimentary canal presents some points of interest. As a general rule the splanchnic arteries consist of two of about equal size, the cœliac and the anterior mesenteric springing close together from the dorsal aorta and supplying between them the greater part of the canal as well as the liver, pancreas, and spleen, and of a small posterior mesenteric supplying the rectum.

In *Scymnus*, on the other hand, there is only a single main artery, the cœliac (figs. 2 and 3, *cœ.a*), which sends off a hepatic branch, and runs backwards along the right side of the stomach, parallel to the bile-duct and portal vein, supplying the left side of the stomach as it goes; it then passes to the dorsal side of the bursa Entiana, and curves round the latter to reach the ventral aspect of the intestine; forming then the duodenal artery (*du. a*) which takes a spiral course round the ventral and left sides of the gut, sending off transverse branches to its walls, as well as the intra-intestinal artery presently to be described. The cœliac also gives off, near the pylorus, a small left gastric artery (*g. a*), which curves round the posterior border of the stomach, and then passes straight forward along its left side.

The rest of the alimentary canal is supplied by no less than three mesenteric arteries, an anterior (fig. 3, *a. m. a*), a middle (*m. m. a*), and a posterior (*p. m. a*); all are small arteries proceeding straight from the dorsal aorta to the right side of the intestine, and forming between them a longitudinal vessel, which runs parallel to the mesenteric vein (*m. v*), sends off transverse branches to the right side of the intestine, and takes altogether a spiral course, so that its distal end comes to lie on the ventral wall of the gut (fig. 2, *p. m. a*). The anterior mesenteric, which is the largest of the three, gives off a lieno-gastric artery (*l. g. a*), which gives branches to the spleen and is continued up the left side of the stomach.

The blood is returned from the intestine by two veins, the duodenal (*du. v*) and the mesenteric (*m. v*), which pass forward with a turn to the right and unite with one another close to the pylorus to form the portal vein (fig. 3, *p. v*): the duodenal runs alongside the artery of the same name (*du. a*), the mesenteric alongside the longitudinal branches of the mesenteric arteries. The duodenal vein receives transverse veins from the intestinal

walls, several small pancreatic veins from the right lobe of the pancreas, and a large anterior splenic vein (*a. sp. v*) from the spleen, as well as the intra-intestinal vein mentioned below: the mesenteric receiving transverse veins from the intestinal walls, and a large lieno-gastric vein (*l. g. v*) which is formed mainly by a longitudinal vein from the left side of the stomach and receives also veins from the spleen. After receiving the lieno-gastric, the mesenteric vein runs through the left lobe of the pancreas, receiving veinlets from it, and unites with the duodenal immediately anterior to that gland. The common portal vein passes dorsal to the bursa Entiana and along the right side of the stomach, parallel with the cœliac artery and bile-duct, receiving as it goes the veins for the right side of the stomach.

In the paper already referred to on the spiral valve of the skate, I described that structure as being supplied entirely by the mesenteric arteries and veins, but stated that the bursa Entiana received a special blood-supply in the duodenal vessels. Owing, however, to imperfect injections, I missed one important point. The spiral valve of Elasmobranchs has, in fact, a double blood-supply: vessels from the transverse branches of the mesenteric—and in *Scymnus*, *Mustelus*, etc., of the duodenal—arteries and veins pass inward to it, but in addition to these its free edge encloses an artery and vein which may be traced forwards into the duodenal artery and veins respectively. The vein in question has been shown by Balfour* to be formed from part of the sub-intestinal vein of the embryo. As far as I know no name has been given to it as it occurs in the adult, and as it corresponds to part only of the sub-intestinal vein, and is known to persist only in the spiral valve of Cyclostomata and Elasmobranchs, I propose to call it the *intra-intestinal vein*, and the artery accompanying it the *intra-intestinal artery*. It attains its greatest dimensions in those sharks which possess a scroll-valve, such as *Zygæna*, *Carcharias*, and *Galeocerdo*,† but is almost equally conspicuous, as I have lately found, in *Mustelus antarcticus* and in *Callorhynchus antarcticus*, both of which have an ordinary spiral valve, although that of the *Holocephali* shows transitional characters to the scroll-valve.‡ In *Scymnus*, as in the skate, the intra-intestinal vein is quite small and easily missed in injecting.

But the most interesting point in the vascular system of *Scymnus* is the presence of a large lateral vein, having the same essential relations as the vein I described in the skate.§ Posteriorly it is connected with the veins from the pelvic fin, from the anterior border of which it passes forwards

* Comparative Embryology, vol. ii., p. 535.

† See Duvernoy, Ann. des Sci. Nat., ser. ii., 1835, t. iii.

‡ See "Spiral Valve of Skate," loc. cit., p. .

§ "On the Venous System of the Skate," Trans. N.Z. Inst., vol. xii., pp. 413–18.

and slightly upwards, parallel with the cutaneous ridge described above, to the pectoral fins, where it is connected with the brachial veins. It thus marks exactly the position of Balfour's lateral ridge, or in other words of the hypothetical ancestral lateral fin. It is worthy of notice that the body-muscles are disposed peculiarly with regard to this vein (fig. 4), a transverse section showing that the muscular bundles are disposed around it in a radiating fashion. The section also shows that the ridge in question is not a mere cutaneous structure like the lateral keels on the tail of *Lamna*, *Carcharodon*, etc., which are formed merely by a thickening of the tough, white, fibrous tissue of the dermis. In the pre-pelvic ridge of *Scymnus*, on the other hand, the skin is no thicker than in other parts, but is moulded on an actual muscular ridge. Throughout the greater part of its course the lateral vein lies immediately beneath the peritoneum.

Physiologically, I am disposed to think that the lateral vein has but little significance, since except at its anterior and posterior ends it receives only the small veins from the abdominal walls. This, coupled with the structural peculiarities just mentioned, seems to confirm the view I advanced in describing the corresponding veins in the skate, namely, that the lateral vein represents the vein of the primitive vertebrate lateral fin. It seems possible also that it may be genetically derived from the lateral vessel of a more remote vermian ancestor, but this is merely a suggestion.

The lateral vein exists also in *Acanthias vulgaris*, *Mustelus antarcticus*, and *Chiloscyllium furvum*, in which, as in *Scymnus*, it is so obvious a structure that, in spite of the absence of any mention of it in the books at my disposal, I feel sure it must have been previously noticed.

4. *Urinogenital organs.*

The kidneys are very long, extending nearly to the anterior boundary of the body-cavity, and apparently representing both meso- and metanephros. That the mesonephros should remain functional in the adult female is noteworthy, since from the analogy of other Selachians it is probably converted in the male into the epidymis. A single ureter runs alongside the inner edge of each kidney, widening posteriorly, and finally dilating into the urinary bladder. Projecting into the cloaca at its anterior end is an unusually large median urinary papilla (fig. 1, *u.p*), on the ventral surface of which, near the apex, is the single urinary aperture; this leads into a comparatively narrow canal in the very thick-walled papilla, and into the anterior end of the urethral passage thus constituted the two urinary bladders open.

The oviducts open into the cloaca by widish apertures (fig. 1, *ut'*), one on either side of the urinary papilla. The posterior part of each (*ut*) is wide, having in the gravid state a considerably greater diameter than either the stomach or intestine, and forming a uterus or brood-pouch: a little

anterior to the level of the bursa Entiana the diameter suddenly diminishes, the uterine portion of the oviduct passing into the Fallopian portion (*f.t*). Each Fallopian tube passes forwards, dilates into an oval oviducal gland (*o.gl*, supposed in the figure to be seen through the liver), this narrows again, curves round the side of the gullet to its ventral wall, where it turns backwards, unites with its fellow, and the common tube thus formed opens into the cœlum by a single trumpet-shaped aperture (*f.t′*). This median common portion of the Fallopian tubes is connected with the ventral body-wall by a vertical sheet of peritoneum or falciform ligament.

The Fallopian tube has its mucous membrane produced into longitudinal ridges: in the uterus these become, as it were, frayed out at their edges, forming longitudinal rows of long villi provided with very large and obvious vascular loops. These serve to furnish a supply of oxygenated blood to the embryos which are retained in the uteri until fitted for independent existence.

The specimen examined was a gravid female, the two uteri containing together ten fœtuses. The presence of the oviducal glands in this form indicates clearly that the viviparous condition is a secondary one, since the function of these glands is the secretion of the horny egg-shell. In this connection it is worthy of remark that the oviduct contained yellowish-brown silky shreds, quite like those found on the undeveloped egg-shell in the skate, and evidently representing a rudiment of that structure. According to Balfour* the egg of *Mustelus*, *Galeus*, *Carcharias*, and *Sphyrna*, is at first enclosed in a delicate shell: if this is the case in *Scymnus* the shell must be thrown off at a very early period.

5. *The nervous system and sense organs.*

The brain presents several points of interest. It is much elongated owing to the great length of the medulla oblongata and thalamencephalon, the optic lobe and cerebellum having the usual proportions (see fig. 7–10). The medulla oblongata (*m. o*) is considerably wider than the spinal cord, and presents above a long shallow fourth ventricle (*v*. 4): at its anterior end it is produced dorsally into large restiform bodies (*r. b*).

The cerebellum (*cb*) has a regularly oval outline; its dorsal surface is marked by a median longitudinal groove, and it is connected with the medulla at about the middle of its length by large cerebellar peduncles (*pd*). It contains a large cavity, the cerebellan ventricle or *metacœle* (*cb. v*), which is in free communication below by a central aperture with the fourth ventricle.

The mid-brain has the usual structure, consisting of a ventral portion, the crura cerebri (*c.c*) and of paired dorsal elevations, the optic lobes (*o.l*); it contains a large cavity in free communication behind with the fourth ventricle, which may be called the *mid-ventricle* or *mesocœle* (*m.v*).

* "Comp. Embryology," vol. ii., p. 33.

In front of the mid-brain comes the greatly elongated thalamencephalon or 'twixt-brain (*thc*); it is best described as a shallow trough, roofed over only by a small band of nervous matter at its hinder end and for the rest by pia mater; the third venticle or *thalamocœle* is thus widely open above, and there are no lateral thickenings answering to thalami optici.

In most Elasmobranchs,—indeed, according to Günther, in all,—there exist on the ventral surface of the thalamencephalon just behind the optic chiasma (*o.c*), paired ovoidal bodies, the lobi inferiores: there is no trace of them in *Scymnus;* the thalamencephalon is merely produced ventrally into a thin-walled tubular infundibulum (*inf*), which extends backwards over the ventral surface of the mid-brain and is continued directly into the hollow thin-walled pituitary body (*pty*). Extending along the middle ventral line of the infundibulum and pituitary body is a flattened one-lobed saccus vasculosus (*s.v*).

The prosencephalon is very interesting: instead of forming a transversely elongated mass, either solid, as in *Raja*, or containing small ventricles, as in *Scyllium*, it consists of a small unpaired hinder portion (*prc*) continuous with and passing insensibly into the thalamencephalon, and of paired, divergent, pyriform bodies, the cerebral hemisphere (*c. h*). Similarly, the cavity of the prosencephalon consists of an unpaired posterior portion (*prc*) which may be conveniently called the *prosocœle*, and is perfectly continuous with the third ventricle, and of paired lateral ventricles (*l. v*). The walls of the whole fore-brain are very thin, and there is no constriction between the lateral ventricles and the prosocœle, or between the prosocœle and the third ventricle.

The olfactory lobes (*olf*) are comparatively short, dilated at their ends, and contain olfactory ventricles (*olf. v*) continuous with the lateral ventricles.

The brain of *Scymnus* is thus seen to exemplify with diagrammatic clearness the typical structure of the vertebrate encephalon. We have the large fourth ventricle; the cerebellum retaining its primitive character of a hollow out-pushing of the roof of the fourth ventricle; the mid-ventricle showing no distinction into aqueduct of Sylvius and optic ventricles, and of approximately equal calibre with the third and fourth ventricles; the prosencephalon, or cerebral rudiment of the embryo, composed of an unpaired hinder portion which bifurcates in front to form the paired hemispheres, and these again continued insensibly into the olfactory lobes; the fore-ventricle or cavity of the fore-brain, in the form of a Y-shaped space, the stem of the Y being represented by the prosocœle and third ventricle, the arms by the lateral and olfactory ventricles; finally all the cavities are large, and their walls but little thickened: this is especially noticeable in the case of the

fore-brain, where there are no thickenings for optic thalami, corpora striata, or lobi inferiores, and no constriction of the prosocœle to form a Y-shaped "foramen of Monro" like the third and lateral ventricles.

The second (ii.), third (iii.), and fourth (iv.) nerves have the usual relations; springing from the anterior end of the medulla oblongata are three chief roots (v., vii., viii.), which I had not the opportunity of tracing, but which, judging from analogy, must be the roots of the fifth, seventh, and eighth nerves: of these one is dorsal in position and posterior to the others, and is evidently the root considered by Balfour* as the ramus dorsalis of the seventh, which goes largely to form the ramus ophthalmicus superficialis of the orbitonasal nerve. A small backwardly-directed nerve behind these roots is probably the glossopharyngeal (ix.), and several large roots towards the posterior end of the medulla the vagus (x.)

There is nothing of special interest about the nasal sacs, and in the eyes the only points I have to mention are the extreme dilation of the circular pupils, and the presence of a beautiful argentea interna or silvery tapetum in contact with the whole extent of the retina. According to Owen this silvery layer of the choroid is internal also in *Galeus*. The auditory organ has the usual structure.

6. *Embryology.*

The few observations I have to make under this head are concerned almost entirely with the external characters of the three stages found in the uteri of the specimen dissected.

First stage.—Of the ten fœtuses, one was very considerably younger than the rest, and had a length of about 7 mm. It is represented in fig. 11. In general form it corresponds pretty nearly with Balfour's "Stage I,"* but presents many differences of greater or less importance.

The head is very sharply separated from the trunk, which latter is strongly arched dorsally and much compressed from side to side. The tail (*c*) is quite short but quite clearly differentiated from the trunk and sharply bent round against the left side. From this latter circumstance it would seem that active movements had already begun, as in Balfour's "I," but the embryos were all dead when I received them. There is as yet no trace of a caudal fin, but the tail can hardly be said to be dilated terminally. Other resemblances to "I" are found in the fact that the cerebral flexure is far from complete, the fore-brain (*f.b*) being still in advance of the mid-brain (*m.b*), in the imperfect condition of the eye (*e*), in the small number of myotomes, and in the great size of the somatic or umbilical stalk (*so.s*) by which the embryo is attached to the yolk-sac.

* Comp. Embryol., vol. ii., p. 378.

* "The Development of Elasmobranch Fishes" (Journ. of Anat. and Phys., vol. x., pl. xxiv.)

In other characters, however, this embryo had advanced considerably beyond "I," and was indeed as far advanced as "M." The mouth (*m*) is large, and its thickened edge due to the presence of the pterygo-quadrate (*pt.q*) and Mechelian (*mn*) bars which afterwards become the upper and lower jaws, is very obvious. There is already the full number of six visceral clefts, of which the first (*sp*) has completely taken on the character of a spiracle: on the anterior edge of the second (first branchial) cleft (*br*.1) are minute denticulations, which appear to be the rudiments of the external gills. Lastly the pectoral fins (*pc*) are well developed, occurring in the form of small outgrowths a short distance behind the last gill-cleft (*br*.5).

It is thus seen that the mouth, the gill-clefts, and the pectoral fins develope far more rapidly in *Scymnus* than in either of the genera (*Scyllium* and *Pristiurus*) studied by Balfour. A *Scymnus* embryo of stage "I" has its pectoral fins as far advanced as a *Scyllium* or *Pristiurus* of stage "L," while its gill-clefts are in the condition of those of the same genera in stage "M." Further observation will be necessary to show whether this is a constant family difference, *Scymnus* belonging to the *Spinacidæ*, *Scyllium* and *Pristiurus* to the *Scyllidæ*, or whether the embryo I have just described is abnormal. I have noticed more than once in *Mustelus antarcticus* one fœtus out of the whole number in a single gravid female in a far more backward stage of development than the rest, and such arrest of development is not unlikely to be accompanied by deformities of some sort.

Second stage.—To this, as to the first stage, only one of the embryos belonged; it was about 18 mm. long, and is shown in fig. 12.

It is, on the whole, intermediate between Balfour's stages "M" and "N," inclining in most respects to "M." The head has a remarkably square outline in side view, the cerebral flexure having proceeded just far enough to bring the fore- and mid-brains (*f.b*, *m.b*) into the same transverse vertical plane. The eye (*e*) is large, and the nostril (*na*) well formed. The distal end of Mechel's cartilage has rotated forwards to such an extent that the axis of the mandible (*mn*) is nearly vertical. The rudiments of external gills are visible in all the branchial clefts but the last: none have as yet appeared in the spiracle (*sp*).

All the fins (*pc*, *pv*, *d* 1, *d* 2) are now formed, and occur in the form of flattened crests, mostly with evenly curved free edges: the caudal fin (*c*) is perfectly diphycercal. The somatic stalk has undergone great relative reduction.

Third stage.—The remaining eight embryos correspond pretty nearly with stage "O" of Balfour, although in correspondence with the fact that the brain is less advanced, in comparison with other organs, than that of *Scyllium*, the cerebral flexure and general features of the head correspond

rather with "L." The mid-brain (fig. 13, *m.b*) forms the anterior termination of the head, and the ventral surface of the fore-brain (*f.b*) looks directly backwards.

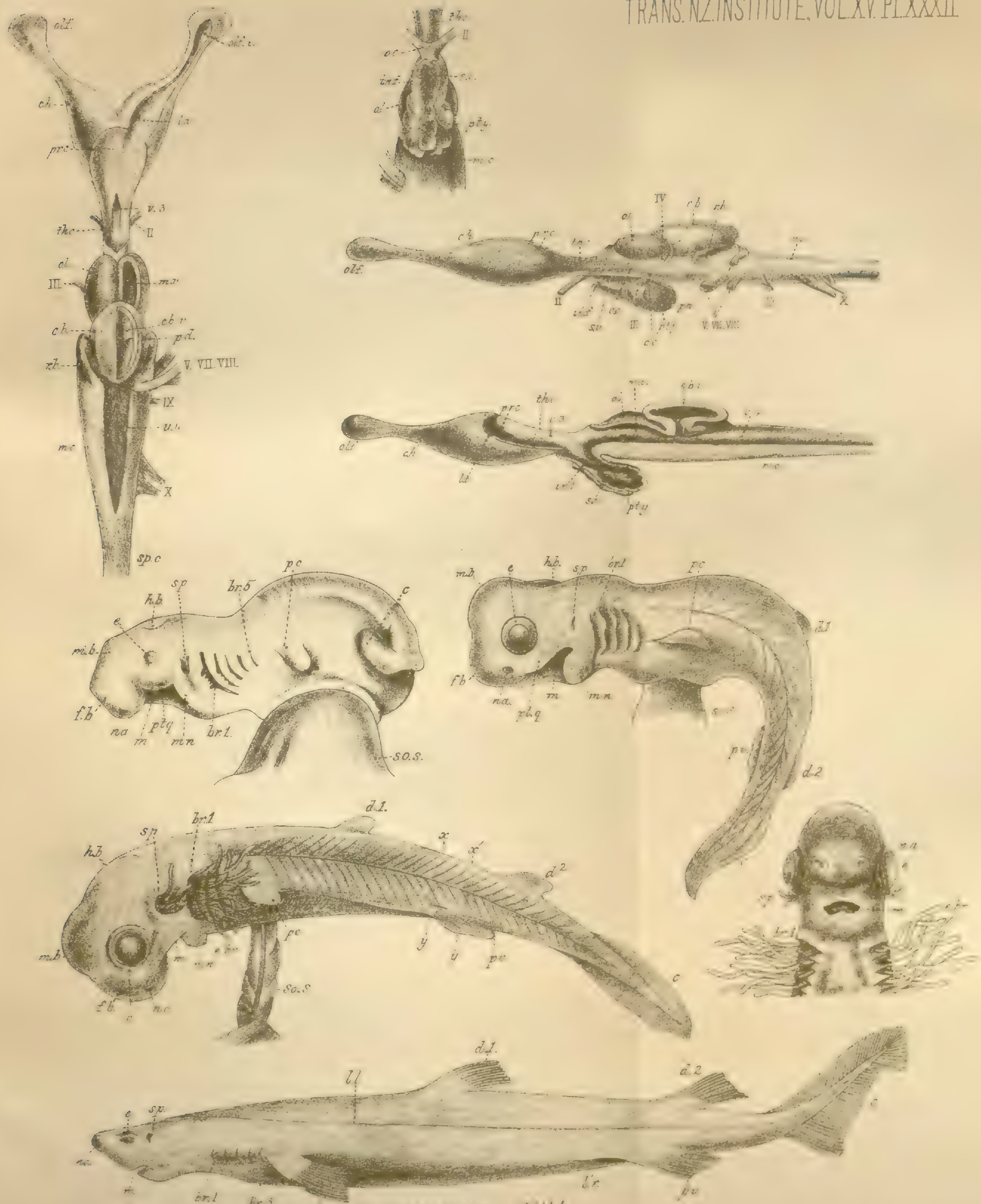
The mouth (fig. 14, *m*) is greatly reduced, and has in fact almost precisely the form, relative size, etc., as in Balfour's "O." So also have the branchial apertures (*br.* 1, *br.* 5), from which as well as from the spiracle (*sp*) the long external gills now emerge. The dorsal (*d* 1, *d* 2) and pectoral (*pc*) fins are beginning to assume their adult form, their line of attachment being no longer their greatest dimension. The caudal fin (*c*) shows the first indication of the change from diphy- to hetero-cercality: on its ventral edge, near the tip, is a slight emargination, evidently the commencement of the very marked notch in the corresponding position in the adult (fig. 15). In front of the anterior end of the pelvic fin (*pv*) the lateral ridge is now visible and has the same relations and proportions as in the adult (fig. 15, *l.r*). The length of the embryo in this stage is about 40 mm.

Up to the present time I have been able to do very little towards the further examination of these embryos, and all I propose to bring forward in the present paper is the fact that in the third stage the lateral vein (figs. 5 and 6, *l.v*) is well developed, and is indeed nearly as large as the cardinal vein (*cd*), and considerably larger than the dorsal aorta (*d.ao*). Of the two sections figured, fig. 5 is taken along the line *xy* in fig. 13, or just in front of the pelvic fins, fig. 6 along *x'y'* or through the pelvic fins. In both figures the lateral vein (*l.v*) is seen to be a very obvious structure, a fact which makes its absence in *Scyllium* and *Pristiurus*—since it is not shown in any of Balfour's figures—somewhat remarkable. Having, unfortunately, no spirit specimen of either of these genera, I have not been able to ascertain whether it exists in the adult: as mentioned above, however, it is present in the allied *Chiloscyllium.*

A few weeks ago I received a letter from Mr. Balfour,* in which the following passage occurs:—"I was very much interested in your paper on the skate's venous system. The lateral veins you describe are very peculiar, and I should not hesitate to consider them as confirming my view of the fins, were it not for the specialized character of the skate, which you yourself urge in your paper. One would like to find them either in the embryo or in some less specialized form."

The necessary confirmation is afforded by the facts detailed in the present paper. The lateral vein exists in every Selachian I have yet had the opportunity of examining: in all it follows the direction of Balfour's lateral ridge, from the anterior border of the pelvic fin forwards and upwards to

* I little thought at the time that this letter was the last I was ever to have from the writer.



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the posterior border of the pectoral: it receives the blood from both pectoral and pelvic fins, but is without important feeders in the intermediate part of its course; and, lastly, it is fully established as a fairly early embryo of *Scymnus*. All these facts tend to support the theory that the lateral vein represents the veins of the primitive vertebrate lateral fins, and is therefore a structure of considerable morphological interest.

EXPLANATION OF PLATES XXXI. AND XXXII.

Fig. 1. Dissection of *Scymnus lichia*, female, made by opening the body-cavity by a median ventral incision; intended to show the general disposition and proportion of the chief abdominal viscera (about $\frac{1}{9}$ nat. size).

ab. p, abdominal pore.
b. e, bursa entiana.
cd. st, cardiac portion of stomach.
cl, cloaca.
f. t, Fallopian tube.
f. t′, common peritoneal aperture of Fallopian tubes.
g. h. o, gastro-hepatic omentum.
int, intestine.
lr, the two lobes of the liver turned forwards to show the other viscera.
o. gl, oviducal gland, shown in dotted outline through the liver.
pn, pancreas.
py. st, pyloric portion of stomach.
spl, spleen.
u. p, urinary papilla.
ut, uterus.
ut′, cloacal aperture of uterus.

Fig. 2. The stomach and intestine from the ventral aspect ($\frac{2}{5}$ nat. size).
Fig. 3. The stomach and intestine from the right side ($\frac{2}{5}$ nat. size).

In fig. 2 the bursa Entiana is opened, as well as a portion of the intestine, so as to show the pyloric and spiral valves.

a. m. a, anterior mesenteric artery.
a. sp. v, anterior splenic vein.
b. e, bursa Entiana.
b. d, bile duct.
cd. st, cardiac portion of stomach.
cœ. a, cœliac artery.
du. a, duodenal artery.
du. v, duodenal vein.
g. a, small left gastric artery.
l. g. a, lieno-gastric artery.
l. g. v, lieno-gastric vein.
m. m. a, middle mesenteric artery.
m. v, mesenteric vein.
p. m. a, posterior mesenteric artery.
pn, right, and *pn′*, left lobe of pancreas
p. v, portal vein.
py, pylorus.
py. st, pyloric portion of stomach.
r, rectum.
r. gl, rectal gland.
spl, spleen.
sp. v, spiral valve.
w, wall of intestine.

Fig. 4. Transverse vertical section through body-wall, a little anterior to pelvic fin (nat. size).

in, integument.
l. r, lateral ridge.
l. v, lateral vein.
m, body muscles.
p, peritoneum.

Fig. 5. Transverse vertical section of an embryo in the third stage, taken along the line *xy* in fig. 13.
Fig. 6. A similar section taken along *x′y′*.

Both figures × 16.

an. d, archinephric or segmental duct.
c, caudal vein.
cd, cardinal vein.
ch, notochord.
d. ao, dorsal aorta.
g, genital ridge.
int, intestine with spiral valve.
i. r, inter-renal body.
k, tubules of kidney (metanephros).
l. v, lateral vein.
my, spinal chord.
msr, mesorectum.
pv, pelvic fin.
r. gl, rectal gland.

Fig. 7. The brain, from above, with the lateral mid, and cerebellar ventricles opened on the right side.
Fig. 8. The middle portion of the brain from beneath.
Fig. 9. The brain from the left side.
Fig. 10. The brain in longitudinal vertical section.

Figs. 7-10, all nat. size.

cb, cerebellum.
cb. v, cerebellar ventricle.
c. c, crura cerebri.
c. h, cerebral hemisphere.
inf, infundibulum.
l. t, lamina terminalis.
l. v, lateral ventricle.
m. o, medulla oblongata.
m. v, mid-ventricle.
o. c, optic chiasma.
o. l, optic lobes.
olf, olfactory lobes.
olf. v, olfactory ventricle.
pd, cerebellar peduncles.
prc, unpaired portion of prosencephalon and prosocœle.
pty, pituitary body.
r. b, restiform bodies.
sp. c, spinal cord.
s. v, saccus vasculosus.
thc, thalamencephalon.
v. 3, third ventricle.
v. 4, fourth ventricle.
II.–IX., roots of cerebral nerves.

Fig. 11. Side view of embryo of first stage (× 10).
Fig. 12. Side view of embryo of second stage (× 6).
Fig. 13. Side view of embryo of third stage (× 3).
Fig. 14. Under view of head of embryo of third stage (× 3).
Fig. 15. Side view of adult female (about ⅛ nat. size).

br. 1, first, and *br.* 5, last gill-cleft.
c, caudal fin, (in fig. 11, end of tail).
d. 1, first, and *d.* 2, second dorsal fin.
e, eye.
e. br, external gills.
f. b, fore-brain.
h. b, hind-brain.
m, mouth.
m. b, mid-brain.
mn, mandible.
na, nasal aperture.
pc, pectoral fin.
pt. q, upper jaw.
pv, pelvic fin.
so. s, somatic stalk.
sp, spiracle.
xy, and *x'y'* (in fig. 13) lines along which the sections shown in figs. 5 and 6 are taken.

Art. XXX.—*On the Connection of the Air-bladders and the Auditory-organ in the Red Cod* (Lotella bacchus). By T. Jeffery Parker, B.Sc.Lond. Professor of Biology in the University of Otago.

[*Read before the Otago Institute, 9th May*, 1882.]

Plate XXXIII.

In his "Study of Fishes"* Dr. Günther says,—"In many Teleostei a most remarkable relation obtains between the organ of hearing and the air-bladder. In the most simple form this connection is established in Percoids and the allied families in which the two anterior forms of the air-bladder are attached to fontanelles of the occipital region of the skull, the vestibulum occupying the opposite side of the membrane by which the fontanelle is closed.

* p. 117.

Rather more than two years ago* a paper was read before the Zoological Society of London, by Professors Bridge and Haddon, on the auditory ossicles of fishes; I was unfortunately unable to hear the paper read and as far as I know it has not yet been published, but before I left England Mr. Haddon was good enough to give me a verbal account of the chief results contained in it. One of these was that in many fishes, notably certain Siluroids, the processes of the air-bladder were produced outwards to the side-walls of the body, where the skin became very thin, forming a sort of tympanic membrane, the vibrations of which were transmitted through the air-bladder to the *ossicula-auditûs* and thence to the organ of hearing.

On dissecting the common Red Cod a short time since, I was interested to find a combination of the two arrangements just described. As no accessory auditory apparatus has, I believe, hitherto been described in any of the *Gadidæ*, I have thought it advisable to present the following account to the Institute.

On the hinder surface of a roughly-prepared skull of *Lotella*, there is on each side of the occipital condyle (fig. 1, *o.c*) a large foramen (*au.f*), bounded internally by the basi- and ex-occipitals (*b.o*, *e.o*), and externally by the opisthotic (*op.o*). If the skull is prepared with sufficient care, this foramen is seen to be filled with an extremely thin plate (*l*), formed partly of bone, partly of membrane: its inner half is strongly plaited and fan-like, and belongs to the basi-occipital: it is separated by a membranous interval from the outer half, which is formed by the opisthotic, and is nearly smooth. This lamina forms the lower part of the posterior wall of the auditory capsule: the foramen, with the lamina stretched across it, may be called the auditory fontanelle.

Immediately below and internal to this fontanelle is a large downwardly directed process (*x*) of the basi-occipital, serving for the attachment of some of the neck muscles, and having its hinder surface concave: immediately external to the fontanelle is a process of the opisthotic (*y*) also bearing a concave surface: and external to this again on the posterior surface of the parotic process is a third facet (*z*) furnished by the pterotic.

The walls of the air-bladder (fig. 2) are for the most part thick and tough, but on the anterior half of its dorsal surface they become so thin as to be hardly distinguishable from the periosteum of the vertebral column. Near its anterior end the bladder becomes markedly constricted, and in front of the neck thus formed dilates considerably, forming the cornua which pass outwards and slightly forwards and upwards with this anterior

* In the early part of 1880, I believe; but strangely enough I can find no notice of the paper in the Index of "Nature."

face closely applied against the posterior surface of the skull. Each cornu fits closely against the three facets already mentioned, and is strongly attached by fibrous tissue to *y* and *z*, as well as to the outer border of *x*.

Over against the auditory fontanelle the wall of the bladder becomes considerably thickened, forming a pad (*p*) which fits tightly into the foramen and comes in close contact with the lamina of the fontanelle, its surface presenting folds corresponding to those in the lamina.

The outer or free end of each cornu of the air-bladder comes in close contact with the thin skin (fig. 3, *a*) immediately in front of the dorsal end of the shoulder-girdle and beneath the operculum (*op*).

The arrangements described must form a fairly efficient transmitting apparatus to the organ of hearing. Sonorous vibrations meeting the thin subopercular skin, will be transmitted to the air in the air-bladder and thence to the auditory fontanelle, the vibration of which will act immediately on the perilymph. The subopercular skin will thus act as an imperfect tympanic membrane, the air-bladder as a tympanic cavity, and the auditory fontanelle as a fenestra ovalis.

EXPLANATION OF PLATE XXXIII.

Fig. 1. Hinder view of the skull of *Lotella bacchus* (nat. size).

au. f, right auditory fontanelle.
b. o, basi-occipital.
e. o, ex-occipital.
ep. o, epiotic.
f. m, foramen magnum.
l, lamina filling up left auditory fontanelle.
op. o, opisthotic.
pt. o, pterotic.
s. o, supra-ocipital.
x, y, z, facets for attachment of air-bladder.
IX, X, foramen for exit of ninth and tenth nerves.

Fig. 2. Anterior end of air-bladder opened from the dorsal side; *p*, pad fitting against auditory fontanelle; *r*, rete mirabile.

Fig. 3. Transverse section taken just behind the head (diagrammatic).

a, place where air-bladder comes in contact with subopercular integument.
br. c, branchial cavity.
ly, lymphatic gland (so called head-kidney).
œs, œsophagus.
p, pad of air bladder.
sp. c, spinal cord.
v. 1, centrum of atlas vertebra.

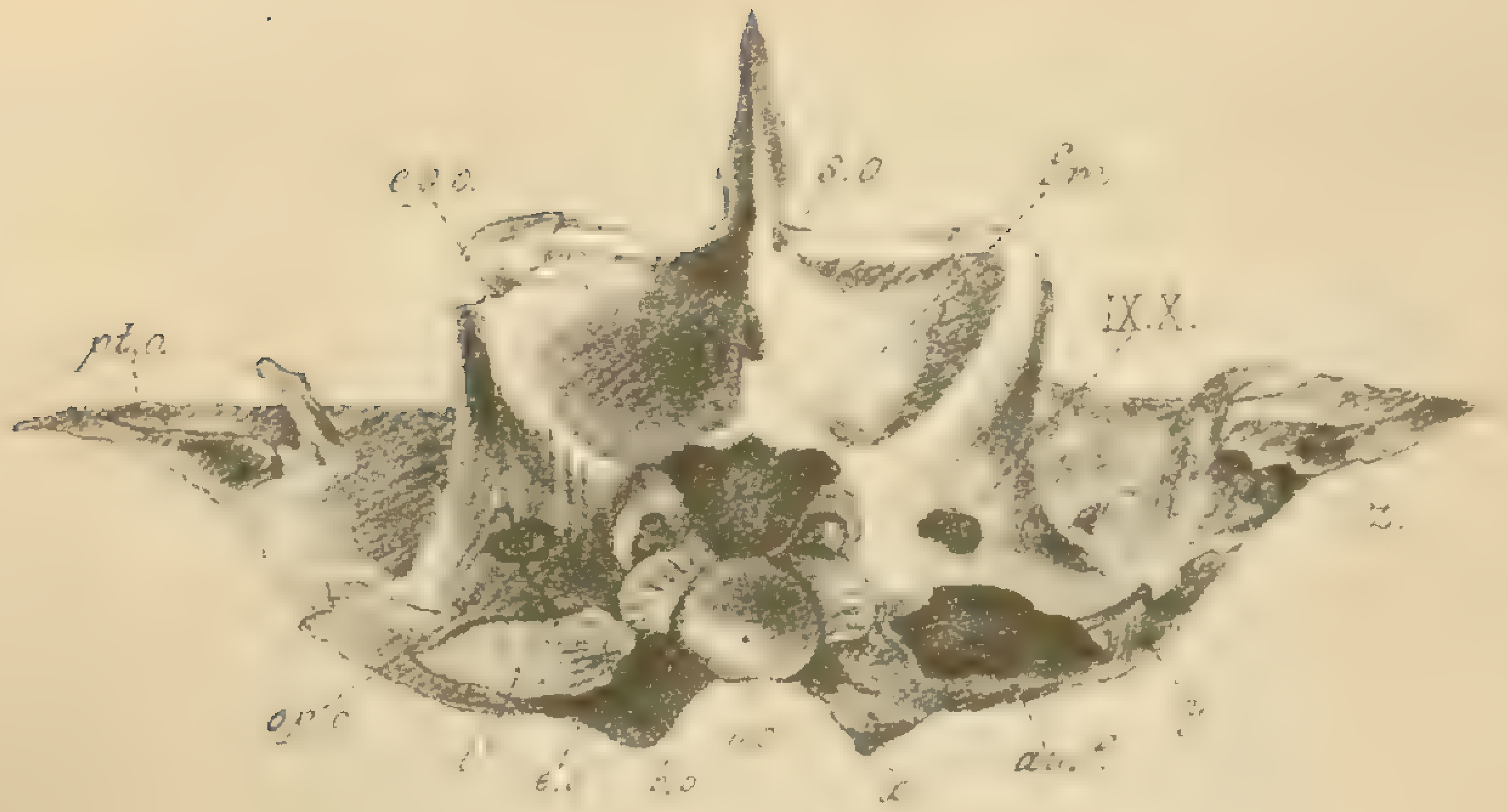


Fig. 1

Fig. 2.

Fig. 3.

LOTELLA BACCHUS.

T.J.P. del.

II.—BOTANY.

Art. XXXI.—*On the New Zealand* Desmidieæ. *Additions to Catalogue and Notes on various Species.* By W. M. Maskell, F.R.M.S.

[*Read before the Philosophical Institute of Canterbury, 5th October*, 1882.]

Plates XXIV. and XXV.

The following paper consists of two parts:—First, a list, with descriptions and figures, of those plants which I have been able to add to my former catalogue; and secondly, notes upon some of the species described or mentioned in my paper, vol. XIII. of the Transactions, 1880, p. 297.

Several of the plants given in the following list have come to me in gatherings from Hawke's Bay, and I must express my thanks to Dr. Spencer, of Napier, who has kindly forwarded these gatherings, and in other ways materially assisted me. Indeed, strictly speaking, I have no right to include these in my paper: but Dr. Spencer informs me that he is not able this year to publish them. I understand that he proposes shortly to describe several new species in other families of Algæ.

In order to mark the plants so sent to me I have put after each the letter S, in all cases where I had not previously found the plant in Canterbury or elsewhere myself.

I have also to thank Professor Nordstedt, of Lund, for sending me papers of his upon Desmidieæ and other Algæ, which have been of great service; also Mr. Joshua, F.L.S., of Cirencester, England, who kindly sent me, a few months ago, a number of tubes containing gatherings of Algæ from various parts of England. In these tubes, although I have not yet thoroughly examined them, I have found, so far, more than fifty species of Desmidieæ, many of which are uncommon, and all have been of great use to me for comparison with the New Zealand forms.

My works of reference have been increased since 1880 by the addition of Rabenhorst's "Flora Europæa Algarum," Pritchard's "Infusoria," the "Annals and Magazine of Natural History," and others. Examination of these has not compelled me to abandon any of the species which I set down in my former paper as new, with the exception, perhaps, of *Staurastrum* (*Didymocladon*) *stella* and *Docidium dilatatum*. The former may possibly be *S. furcigerum* or *S. sexangulare*: the latter is said by Mr. Archer to be probably *D. ovatum*, Nordstedt.

I have been fortunate enough in the last two years to find some species of Desmidieæ in conjugation, with attached zygospores, notably *Cosmarium*

tetraophthalmum, *Closterium acerosum*, *Clost. lineatum*, *Penium margaritaceum*, and a few more. Still, conjugation seems to be very rare here, and Dr. Spencer tells me that it is equally so in Hawke's Bay. By the way, it is curious how capricious the Algæ often seem to be in their appearance and disappearance. For example, two years ago, *Micrasterias rotata* and *M. ampullacea* swarmed in some pools. This year both are exceedingly scarce about Christchurch. *Volvox globator* was to be found, in 1878 and 1879, in myriads: since then I have seen very few, and during the last twelve months not a single specimen.

It will be observed that, with the help of the Hawke's Bay gatherings, I have been able to add three genera to the New Zealand Flora, viz., *Desmidium*, *Xanthidium*, and *Arthrodesmus*; but I have not found any of these in Canterbury.

The measurements adopted in this paper are expressed in the modern nomenclature which, as I understand, microscopists in Europe are endeavouring to bring into general use. Instead of the old "inch," and fractions of it, which were only intelligible to Englishmen, micro-measurements are now expressed by the symbol μ, representing a *micro-millimetre*. One $\mu = \frac{1}{1000}$ millimetre $= \frac{1}{25000}$ inch almost: so that, for example, instead of saying that *Micrasterias rotata* has a length of $\frac{1}{90}$ inch, one would say nowadays 278 μ. This mode is intelligible to observers of all countries, and is undoubtedly preferable to the old one.

I regret to say that a little ditch near the Fendalton Road, which has supplied me with some of the most curious of the New Zealand Desmids, including *Triploceras tridentatum*, *Staurastrum aculeatum*, and others, will soon be no longer available. At the best it was only a little "grip" in a field, almost dry in summer; and it was always a puzzle to me how so many uncommon forms got there, especially as it could not have existed many years. But now the march of progress is rapidly effacing it, and the streets of the flourishing village of Bryndwr will probably in a few weeks destroy it altogether. The worst of it is that I know no other habitat in Canterbury for some of these forms.

Part I.

Additions to Catalogue of New Zealand Desmidieæ.

1. **Desmidium**, Agardh.

D. swartzii, Agardh. S. (R. IV.)

Not uncommon, apparently, in Hawke's Bay. It has not been found in Canterbury.

D. aptogonium, Brébisson. S. (R. XXXII.)

I have not seen this plant, which Dr. Spencer informs me occurs very rarely in Hawke's Bay.

2. **Sphærozosma**, Corda.

S. pulchrum, Bailey. S. (R. XXXV.)

Occurs in Hawke's Bay, rarely. I have not seen it. Mr. Archer (in Pritch. Inf., p. 724) includes this plant in the genus *Spondylosium*, as it has no processes uniting the joints. Rabenhorst considers *Spondylosium* only a sub-genus of *Sphærozosma*.

3. **Euastrum**, Ehrenberg.

E. ansatum, Ehrenberg. S. (R. XIV.)

Not uncommon. From Hawke's Bay.

4. **Cosmarium**, Corda.

C. ralfsii, var. β, var. nov.

Fig. 1.

Differs from the normal form only in its size, which is very small. Length in front view, 37·5 μ; breadth, 25 μ. But these dimensions are quite constant, and the larger form has not been present with it in any gathering which I have observed. Were it not for the slightly triangular segments it might be *C. cucumis*; it cannot be *C. pyramidatum*, as the frond is smooth.

C. thwaitesii, Ralfs. (R. XVII.)

Fig. 2.

Rare.

I am doubtful about this plant, as I find no trace whatever of any gelatinous covering, whether for single fronds or colonies. Ralfs says of it, "puncta very indistinct:" the plant here is smooth. Length, 44 μ.

C. pusillum, Brébisson.

Fig. 3.

This is the smallest plant of the genus known to me. I copy Mr. Archer's description (in Pritch. Inf., p. 731): "Frond very minute, slightly broader than long, constriction acute, segments *angulato-trapezoid*, slightly narrowing upwards, smooth, angles rounded, ends slightly concave." I think, however, that the plant here is punctate. The plant is scarcely visible below a power of 200 diameters. Length of frond, 12 μ; breadth, 15 μ.

Hitherto described only from France (Brébisson) and Saxony (Rabenhorst).

Not common. I have specimens dividing, but no zygospores.

C. punctulatum, Brébisson.

Very similar to a young state of *C. margaritiferum*: indeed Mr. Archer (in Pritch. Inf., p. 733) unites the two. Rabenhorst is doubtful on the point.

Common, both in Canterbury and Hawke's Bay.

C. gemmiferum, Brébisson. S.

Fig. 4.

A large, handsome species, of the general appearance of *C. margaritiferum*, covered with conspicuous pearly granules, but differing by having on each segment, at the middle, on both surfaces, a rounded protuberance bordered with granules, which is best seen in end view. (Pritch. Inf., p. 733.)

The typical plant has slightly truncate ends; in our species the truncation is sometimes not apparent.

Seemingly not uncommon in Hawke's Bay. The European species has only been found, I think, in France.

C. obsoletum, Hantzsch, var. *punctatum*, var. nov. S.

Fig. 5.

Frond in front view almost circular, the breadth perhaps a little more than the length. Edge smooth. Constriction deep, narrow, linear. Segments broader than long, with a minute, bluntly-triangular process on each at the entrance of the constriction on each side; processes convergent, pointing slightly outwards. End view elliptic, showing the processes. Surface of frond distinctly punctate. Diameter in front view, 60–65 μ. Zygospore unknown.

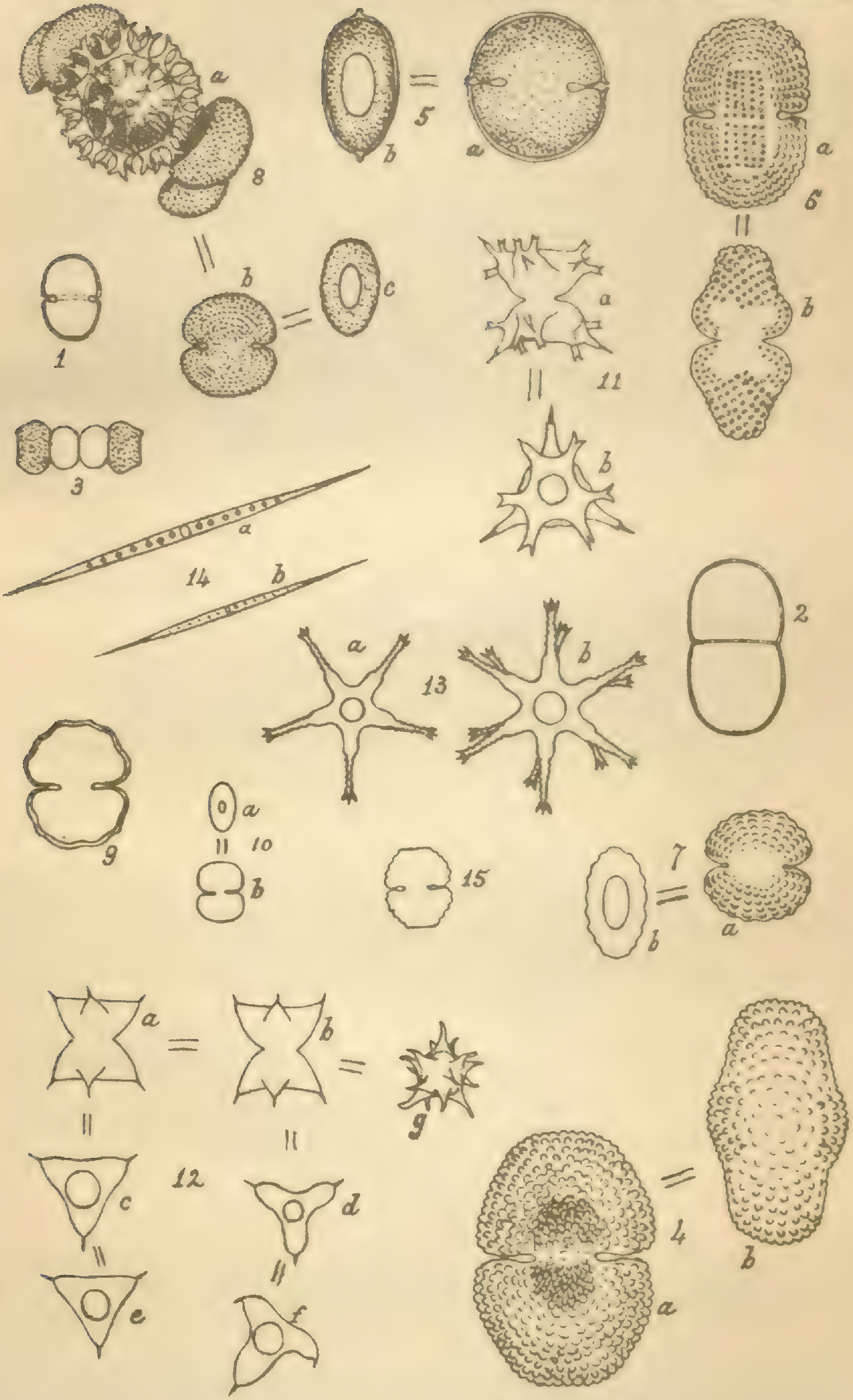
Not uncommon in gatherings from Hawke's Bay.

Professor O. Nordstedt, in a paper which he has kindly sent me on some Algæ in the museum of Lund, figures a species from Java—*C. obsoletum*, Hantzsch, closely resembling the above. The same plant is found in Rabenhorst (Flor. Alg., sect. iii, p. 227) as *Arthrodesmus obsoletus*, a variety of *A. convergens*. Neither author, however, gives more than the very briefest description. But Prof. Nordstedt's figure clearly shows his plant quite smooth, without puncta. In other respects I see no difference, and I think the puncta are not sufficient to raise our plant above the position of a variety.

C. speciosum, Nordstedt, var. *inflatum*, var. nov.

Fig. 6.

Frond in front view elliptical, the ends not at all or very slightly compressed; segments longer than broad, sides convex; constriction deep, narrow, linear. Segments when empty showing rows of minute semiorbicular granules, the rows apparently *radiating* from the centre of each segment, but not reaching quite to it, so that the median space would be smooth if it were not for a number of *longitudinal* rows of smaller granules, which rows, being slightly curved and not all in focus at once, testify to the presence of a central inflation. The result of the two sets of granules is to



NEW ZEALAND DESMIDIEÆ.

W.M.M. del.

give a laterally-grooved appearance to the segment and a minutely undulate appearance to the edge, while the central portion seems longitudinally costate.

In side view each segment is angular-elliptic, the end somewhat truncate; and a broadly rounded inflation is distinctly visible at each side.

End view elliptic.

Length of frond 72 μ; breadth in front view 50 μ; breadth at inflation in side view 37 μ; breadth at constriction 25 μ.

Not common: as yet only from the ditch at Bryndwr, near Fendalton, where *Triploceras tridentatum* occurs, and very rarely in gatherings from Hawke's Bay.

I had long been puzzled by this plant, and had come to the notion that it might be a new species. But my English gatherings from Mr. Joshua have been useful here. One of them is labelled, "*C. speciosum* var. *biforme*, Nordstedt," and seems to contain scarcely any other Desmidieæ; and the European plant appears to correspond closely with ours. The differences are, that in the New Zealand plant the central inflation is quite distinct, especially in side view, and the ends are either round or only compressed very slightly, in front view. I rather think also that the granules are smaller than in the English form.

I have met with no description of the European *C. speciosum*. Neither Ralfs, Rabenhorst, nor Pritchard mentions it; and the only reference which I have found in Professor Nordstedt's papers is a statement that it occurs very sparingly in the Sandwich Islands.

The term "*biforme*" attached to my English specimens refers, I presume, to the fact that some of them approach in outline rather to *C. botrytis*.

C. cyclicum Lundell, var. *ampliatum*, var. nov.

Fig. 7.

Frond in front view orbicular, each segment being about twice as broad as long. Constriction linear, not deep, gaping. Segments when empty showing a number of minute semi-orbicular granules, arranged in rows radiating from the centre, so as to give a grooved appearance to the frond and an undulate appearance to the edge. The ends are not at all compressed.

End view elliptic: the edge undulate.

Diameter of frond in front view, either way, about 50 μ: breadth at constriction 25 μ.

Rare: as yet only from a ditch on the Sumner Road, near Lyttelton, in company with *Penium margaritaceum*.

I have not seen Lundell's description of his plant, which appears to be very rare in England. But, in the "Midland Naturalist," vol. iv., 1881, I find *C. cyclicum* figured by Mr. A. W. Wills, without description. Assuming, as is most probable, that this figure is accurate, the English plant differs from ours in having a deep narrow constriction, so that the segments approximate quite closely and indeed touch each other. In the New Zealand variety the wide shallow constriction is quite conspicuous, and the segments diverge from each other at once.

C. botrytis, Bory. (R. XVI.)

In my former paper I expressed doubts as to this species; but many specimens have since come under my observation and there is no doubt that the plant occurs here plentifully. It is common near Christchurch and in the Cust Valley.

C. tetraophthalmum, Kützing. (R. XVII, XXXIII.)

Var. α, the large form. S.

I have no specimens from Canterbury which I can with certainty refer to this plant, but several occur in gatherings from Hawke's Bay. I see no difference between it and the English plant.

Var. β, the small form.

Fig. 8.

The frond is small, more orbicular than in var. α, the segments being broader than long and the pearly granules are much smaller, indeed inconspicuous. I should not have considered the two as the same species, were it not that in one of Mr. Joshua's English gatherings I find a plant (apparently identical with this) which is labelled "*Cos. tetraophthalmum*, small form, zygospores, not *botrytis*, *fide* Nordstedt." In that gathering are some specimens in conjugation, and I have been fortunate enough to find one here also in the same condition, as shown in my figure. I may observe that Ralfs, in his description of the large form, says,—"the sporangia are large and their spines finally branched;" but in his pl. xxxiii. he figures the spines as subulate. Those of my English specimens are also subulate, but probably in both instances the zygospores are not mature.

Length in front view, 44 μ; breadth, 40 μ; diameter of zygospore, including spines, 65 μ.

Rare: from Lyttelton.

C. undulatum, Corda, var. β, var. nov. (?)

Fig. 9.

The distinctive character of this plant is its small size, the length being only 33 μ, the breadth about the same. In Ralfs' plate xv. two sizes are shown, but both are larger than our plant, and the measurement given in the same work is, length $\frac{1}{416}$ of an inch, or about 63 μ.

C. tenue, sp. nov.

Fig. 10.

Frond sub-orbicular, the segments slightly broader than long. Ends rounded. Edge smooth; constriction deep, narrow, linear. Frond neither punctate nor granulate. A single starch vesicle is visible in the centre of each segment.

End view elliptic.

Length of frond 15·5 μ; breadth at constriction 8 μ.

Not common: my specimens were all found amongst *Chara*, in running water, near Christchurch.

This is a very minute plant, scarcely larger than *C. pusillum*. It nearly resembles *C. bioculatum*, Brébisson, but differs in the absence of the distinct isthmus which, according to Ralfs, connects the segments of that species, and in having a deep and narrow, instead of a wide and gaping, constriction. *C. exiguum*, Archer (Micr. Journ., 1864, pl. vi.), has oblong segments. I find none of the minute *Cosmaria* described exactly corresponding to this form. It has not the colour of *C. tinctum*, Ralfs.

5. **Xanthidium**, Ehrenberg.

X. cristatum, Brébisson. S. (R. XIX.)

I have not found this plant in Canterbury. It seems to be not uncommon in Hawke's Bay.

X. aculeatum, Ehrenberg. S. (R. XIX.)

Same remark as for the last species.

6. **Arthrodesmus**, Ehrenberg.

A. incus, Brébisson. S. (R. XX.)

Only from Hawke's Bay.

A. convergens, Ehrenberg. S. (R. XX.)

Only a single specimen observed, in a gathering from Hawke's Bay. The spines on the ends of the segments in this specimen were sigmoid, bending slightly outwards.

7. **Staurastrum**, Meyen.

S. dilatatum, Ehrenberg. (R. XXI.)

Not uncommon.

S. alternans, Brébisson. (R. XXI.)

Rare.

S. tricorne, Brébisson. S. (R. XXII.)

I cannot identify any of my Canterbury specimens with this form, which appears to be common in Hawke's Bay.

Rabenhorst considers the two last as only varieties of *S. dilatatum*. The distinction between *S. alternans* and *S. tricorne* is very slight, depending upon a minute prolongation of the angles of the latter into short processes.

S. punctulatum, Brébisson. (R. XXII.)

Common.

Distinguishable from *S. dilatatum* chiefly by the more turgid segments and generally rougher frond.

S. aculeatum, Ehrenberg. (R. XXIII.)

Not common: as yet only from the Bryndwr ditch. It is curious that this ditch, perhaps twenty yards long, a couple of feet wide, and a few inches in depth, should have contained so many species of Desmidieæ, most of them too of great interest and beauty.

S. spinosum, Brébisson. (R. XXII.)

Very rare: indeed I am not sure that this plant occurs here. Rabenhorst makes it only a variety of *S.* (*Xanthidium*) *furcatum*, Ehr., a plant which Ralfs mentions only doubtfully.

Some specimens in gatherings from Hawke's Bay were referred by Dr. Spencer to this species, but on close examination appear to me to be rather the next.

S. eustephanum, Ehrenberg, var. *emarginatum*, var. nov.

Fig. 11.

Frond in side view deeply constricted at the middle: the constriction wide, gaping. Segments sub-elliptic, the lateral margins convex or turgid, the outer margins nearly straight, sometimes concave. At each angle appear three spines, not in the same plane: the terminal spine long, subulate, tipped with a sharp awn, the two others shorter, cylindrical, forked at the tip. These processes are quite smooth, but I think there is sometimes a minute punctation on the frond. In an empty frond the terminal processes of the third angle can be seen foreshortened on the segments. There are no processes on the edges, except at the angles.

Frond in end view triangular, the sides of the triangle emarginate, or widely crenate, being a little inflated at the middle. Each angle terminates in a somewhat elongated cylindrical or subulate process tipped with a sharp awn. On the sides, close to the angles, are seen six other processes, shorter than the terminal ones, cylindrical, and forked at the tip, and the bases of these are conjoined; they are not on the plane of the triangle, so that they present somewhat the appearance of a star with six short rays. At the base of the fork, on each process, there is an exceedingly minute spine. The processes are smooth and project a little beyond the sides of the triangle, not perpendicularly to the sides but pointing somewhat towards the angles.

The whole plant is very minute; average length of segments in side view (exclusive of processes) 23μ: length of side of triangle in end view (exclusive of awns) 25μ; length of awns 4μ.

At first sight this plant might be taken, in side view, for *S. spinosum*, or in end view for *S. monticulosum*, Brébisson. But it differs from the former in having its outer edges less turgid than the inner and in its processes not being on the same plane; from the latter in the more cylindrical lateral processes and their forked tips. The nearest resemblance to it is, I think, *S.* (*Desmidium*) *eustephanum*, Ehrenberg, an American plant, referred to by Ralfs, p. 215, without figure, and described and figured in Pritchard's Infus., p. 743 and pl. ii., fig. 3. The differences are that in the New Zealand plant the sides, in end view, are emarginate and not rectilinear as in the American variety, and the lateral processes project beyond the sides, whereas in Pritchard's figure they are very small and do not reach the sides. In *S. senarium*, Ehrenberg (also American), similar processes project, but there is also a second series of six others, shorter and in almost corresponding directions, behind the first. In the "Midland Naturalist," vol. iv., pl. v., Mr. A. W. Wills figures *S. pseudofurcigerum*, Reinsch, not unlike our plant in end view, but it is covered with minute spines on the processes as well as on the frond, and the side view is also different.

On the whole, I take this plant to be intermediate between *S. eustephanum* and *S. senarium*.

S. clepsydra, Spencer (in lit. cum specim.), sp. nov. S.

Fig. 12.

Frond somewhat large, smooth. Segments in side view broader than long, widening rapidly from the constriction which is not deep. The external edges are either straight or oftener slightly concave: lateral edges convex. Ultimate angles ending in a fine awn or mucro. In consequence of the shallow constriction the segments are closely united at the base, the junction is broad, and there is no isthmus or band whatever. The apex of the third angle with its awn is usually visible beyond the external edge of each segment.

Frond in end view triangular; the sides equal, slightly concave: somewhat mammillate at the angles which are terminated by the awns. The concavity of the sides is not always conspicuous.

Frond quite free from puncta.

I have seen no zygospores attached to fronds, but in every gathering there are a number of bodies which may not improbably belong to this plant. They resemble generally those of *S. dejectum*, but have fewer spines. I have been able to compare them not only with Ralfs' figures of *S. dejectum*, but also with zygospores of that species in my English gatherings.

Length of frond in side view 31–40 μ; breadth at external edge of segments (exclusive of awns) 30–35 μ; breadth at constriction 15–17 μ; side of triangle in end view 30–35 μ; length of awn 5 μ.

It appears to be abundant in Hawke's Bay, at least in one locality. I have not found it in Canterbury.

This plant at first sight bears great resemblance to *S. dejectum*, Bréb., and indeed, when seen in end view, is not to be distinguished from that plant. But, as Dr. Spencer remarks in his letter to me, the broad junction of the segments in side view renders it distinct. Ralfs observes of *S. dejectum* that "its segments are connected either without a band or with a very short one:" the expression of Rabenhorst is—"sinu amplo, acutangulo vel obtusangulo;" but no conclusion could be drawn from either phrase that the segments of the European plant are so closely and broadly joined as those of *S. clepsydra*. Indeed, Ralfs gives the breadth at constriction of *S. dejectum* as $\frac{1}{2732}$ inch, which is much smaller than that of the New Zealand plant. If *S. cuspidatum*, which differs from *S. dejectum* chiefly in the length of its connecting band, is considered a good species, the same rule might well be observed for *S. clepsydra*.

S. cuspidatum, Brébisson. (R. XXI.)

Not common. Two specimens from Canterbury, and a few from Hawke's Bay.

S. (*Didymocladon*) *furcigerum*, Brébisson. S. (R. XXXIII.)

Fig. 13.

The specimens which I have seen have all either five or six radiating processes in end view. Rabenhorst unites *Didymocladon* with *Staurastrum*, and says that the plant may have 3–4–6–7–8–9 rays: he omits 5. In all my specimens the rays in focus at the extreme end have the other series behind them in exact, or almost exact, correspondence with them, as shown in my figure.

For comparison with my *D. stella* (Trans., vol. xiii., p. 308) see below, under that species, in the second part of this paper.

Only from Hawke's Bay, where it seems to be not uncommon.

8. **Penium**, Brébisson.

P. margaritaceum, Ehrenberg. (R. XXV. and XXXIII.)

I have specimens which, I think, can be referred to all the three varieties, α, β and γ of Ralfs. Rabenhorst unites the two first, and indeed here they all occur mingled together. As for the third, the main difference between it and the others, in England, appears to be the smaller size of its granules. None of my specimens show such large granules as are figured by Ralfs, but some are slightly constricted at the middle, while others show no constriction.

I was fortunate enough to find, on one occasion, a large quantity of this plant in full conjugation, with attached zygospores: there seems to be nothing to distinguish it from the English species.

From the Sumner Road, Lyttelton, and very rarely from the Cust Valley.

P. jenneri, Ralfs. (R. XXXIII.) or

P. brebissonii, Meneghini. (R. XXV.)

I have great doubts which of these two occur here, or indeed whether either has come under my observation. Possibly I have mistaken *Cosmarium thwaitesii* for it. If *P. brebissonii* always occurs in colonies in mucous strata, then I have not seen it.

Very rare, in any case.

9. **Triploceras**, Bailey.

I observe that Rabenhorst and other algologists place this genus, with some of the *Docidia*, under Naegeli's genus *Pleurotænium*, so that probably Bailey's name must be given up.

T. tridentatum, mihi, var. *cylindricum*, var. nov.

In vol. xiii. of the Trans., p. 311, I described a plant of this species with a rectangular section. The present variety is circular in section, and of a generally thicker form. Otherwise there seems to be no difference, and the two are found together.

From the Bryndwr ditch, and also, rarely, from Hawke's Bay.

10. **Closterium**, Nitzsch.

C. griffithii, Berkeley.

Fig. 14.

Fairly common. Length, from 110–160 μ.

C. venus, Kützing.

I see that Rabenhorst considers this as a separate species, though Ralfs unites it to *C. dianæ*. As far as I can make out, the main difference between the two is that *C. venus* is the smaller. However, the dimensions appear to be constant.

C. ehrenbergii, Meneghini. (R. XXVIII.)

Not uncommon.

Distinguishable, especially from *C. selenæum*, mihi, by its thick rounded ends and by a conspicuous median inflation of the inner margin. As to this, see below, under *C. selenæum*, in Part II. of this Paper.

11. **Spirotænia**, Brébisson.

Sp. obscura, Ralfs.

Very rare.

This plant is subject to the same disadvantage as *Sp. condensata*. Its distinguishing character is the spiral endochrome and this is quite destroyed by all the preserving fluids which I have tried.

12. **Scenedesmus**, Meyen.

Rabenhorst relegates this genus to the Palmellaceæ but as other authors include it among Desmidieæ I leave it.

S. acutus, Meyen, var. *dimorphus*, Kützing. (R. XXXI.)

The cells are pointed, closely arranged in a single even row and the two outer ones are lunate.

Not common.

S. obtusus, Meyen. (R. XXXI.)

The cells are ovate or oblong and not in an even straight row.

Common.

Part II.

*Notes on some of the Desmidieæ described in my former paper.**

I have had the advantage lately of perusing, in vol. x. of "Grevillea," No. 53, Sept. 1881, an article by Mr. Archer reviewing my paper on New Zealand Desmidieæ. It has been a great satisfaction to me that so acknowledged an authority does not find grave fault with the descriptions which I gave of my new species, nor, in general, with the paper itself; and Mr. Archer's remarks have gone far to clear up some points upon which I have been in doubt. I take this opportunity of referring again, in a more or less explanatory way, to some of the plants therein mentioned, as well as to some others that Mr. Archer makes no comment upon.

Previously, however, I must touch upon a point referring to the whole family. Mr. Archer agrees with me in thinking that there is great reason to believe many of the Desmidieæ to be cosmopolitan, but he goes on to remark that my "identifications of certain species may not be thoroughly correct." The same thought was certainly in my own mind when writing my paper; and in my introductory remarks I observed that "in many of the species which I have set down here as European, more especially perhaps in the genus *Cosmarium*, I have noticed peculiarities which do not seem to have been mentioned by authors. The discussion of these would lead me beyond the scope of this paper and perhaps the characters to which I refer would not even suffice to raise the plants even to 'varieties.'" In point of fact, three reasons prevented me from attempting to differentiate these plants from European species. First, the dearth of works of reference, for it was impossible to tell whether the minute characters noticeable were referred to or not by any author elsewhere. Secondly, a doubt whether these characters might after all only have been overlooked, or erroneously referred to, by previous observers; and an instance of this is afforded me in Mr. Archer's paper in "Grevillea," where *Staurastrum avicula* is stated to be really, in England, "not a smooth species, but rough," and this was a plant regarding which I expressed doubts in my paper and which

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* Trans. N.Z. Inst., vol. xiii., 1880, p. 297.

is now stated to have been wrongly figured in Ralfs. And, thirdly, I was unwilling, unless fortified by more evidence, to multiply species and varieties or to introduce confusion, if I could help it.

Mr. Archer's doubts as to some of my identifications are therefore, I confess, not unwarranted, and it is quite possible that future observers, noting the peculiarities of our New Zealand Desmids, minute as these peculiarities often are, may go beyond me and endeavour to raise the plants to distinct rank. Still, even now, when I have had the advantage of longer examination and extended means of reference, I hesitate to do so. In the cases of some plants, specially mentioned in Mr. Archer's paper, notes and explanations will be found in the following pages: as regards many of the others, want of time has prevented me from devoting to them so close an observation as would be necessary to elucidate such minute features. As will be seen below, I am almost tempted to boldly make a new species of the plant which, in my former paper, I referred to *Micrasterias rotata*; but even in that case I refrain from doing so.

Sphærozosma excavatum, Ralfs.

I find that this plant is somewhat less rare than I thought it to be; but still I can by no means consider it common: and in consequence of its great fragility connected filaments are found much more seldom than separate joints.

Micrasterias rotata, Greville; and

Micrasterias denticulata, Brébisson.

Fig. 16.

With regard to the distinction between these two, I find from Mr. Archer's paper that that there is no doubt about it, owing to the difference between the zygospores. These I have never yet seen, and my only means of distinguishing were the teeth of the lateral lobes; and as both sharp and truncate teeth are found here indiscriminately, sometimes all round the frond, sometimes sharp on one segment and truncate on the other, sometimes both sharp and truncate on the same segment, I am still greatly in doubt whether *M. denticulata* occurs here at all.

And now as to our *M. rotata*. Is it identical with the English plant, or so nearly so as to be considered the same, or shall it be erected into a new species? Here my doubts arise from the second of the sources mentioned just now; that is, an uncertainty whether some of the features noticeable here may not occur in European plants but have been either overlooked by authors or mentioned somewhere unknown to me.

The first difference is size. According to Ralfs the dimensions of *M. rotata* are,—length, $\frac{1}{91}$ inch; breadth, $\frac{1}{104}$ inch: and Rabenhorst's measurements apparently agree with this. Reduced to modern nomen-

clature this would be: length 274 μ; breadth, 240 μ. All my New Zealand specimens which I can consider as full grown have a length not less than 320 μ, and many range as high as 400 μ. The average difference is shown in the diagram, fig. 16*d*.

Secondly, I think the teeth of the lateral lobes are more numerous, and sharper, than those of the European plant, supposing that is that Ralfs' figure may be taken as the general form. My figure 16*a* shows the number and character of the teeth in a full-grown plant.

Thirdly, and this is probably an important character, the extremity of the end lobe shows divisions which I am not sure that I find in previous descriptions. As shown in fig. 16*a*, and more highly magnified in 16*c*, the extremity of the end lobe has the two teeth at the angles, but it is also deeply divided by a median elliptical cleft, and at the opening of this cleft, on each side, are two short spines or teeth, each pair converging so as almost to close the cleft; and the pairs are not on the same plane, the lower ones appearing as if from a mammillate inflation on the subdivision of the lobe,

Are these specific distinctions? I am not prepared to say. With regard to the last, Rabenhorst's phrase is—"lobo polari angusto cuneato prominulo, in apice *plus minus profunde* sinuato- vel undulato-exciso, angulis oblique truncatis vel bidentatis." Mr. Archer (in Pritchard, Inf. p. 727,) says, "End lobe very slightly exserted, its angles very slightly produced, bidentate, ends emarginate." Possibly neither phrase can be construed to include such a cleft as that shown in our plant. As for the spines, they might at first sight be taken for those of *M. fimbriata*, but they are less hairlike than in that plant, and besides there is never any sign whatever here of the spines seen on the teeth of *M. fimbriata*, in the lateral lobes.

In my figure 16*b* I represent a specimen which only once came under my notice, amongst perhaps a dozen of the ordinary form, and which I take to be a young state of the plant. It is smaller in size, but the cleft of the end lobe is there. The angles of that lobe are scarcely bidentate, and the spines at the cleft are inconspicuous. And the teeth of the lateral lobe are of irregular form, some truncate, some sharp. It appeared to me that the specimen was certainly immature.

On the whole, I hesitate yet as to the identification of this plant, and being unable to make up my mind on the point, leave it as *M. rotata*. In the character of the endochrome, in the arrangement of the amylaceous vesicles, and in the mode of self-division (as noted in my former paper) it resembles the European species. When a zygospore is found, the doubt may be cleared up, but we may have to wait some time for that.

I have already mentioned that this plant, which was common here two years ago, has been very scarce of late: and no sign of conjugation has as yet come under my observation.

Holocystis incisa.

Mr. Archer unites this to *Micrasterias* (other authors, I find, include it under *Tetrachastrum*); and he states that instead of being identical, as I had thought, with Dr. Wallich's Indian plant, it is probably the same as a plant from Sweden, reported by Cleve and called *M. decemdentata β upsaliensis.*

Euastrum binale, Turpin.

The plant mentioned by me (vol. xiii., p. 306) as either this or *E. elegans* is certainly *E. binale*, as I have satisfied myself by comparison with Ralfs' figures, and with specimens in my English gatherings. *E. elegans* shows the sides of the terminal notch extending considerably beyond the lateral spines. I regret to say that the figure 26 in vol. xiii., pl. xii., is about as unlike the plant which it is supposed to represent as it is possible to be; and unluckily Mr. Archer has been misled by it to take my *Euastrum* for a new thing. My original drawing was meant to be, and I think was, almost exactly resembling Ralfs' figure 8 *d* (or 8 *f*) in his pl. xiv.

Cosmarium margaritiferum.

I believe that several of the forms supposed by me to belong to this species were really *C. tetraophthalmum*, *C. broomeii*, etc., or at least closely allied to them. *C. biretum* I have never seen here: *C. botrytis* is certainly common. The conjugation of *C. margaritiferum* I saw once, and could detect no difference from the European plant. In this case also the printed figures in pl. xii., vol. xiii., figs. 27, 28, and 29, are unsatisfactory. Fig. 28 was intended to show a slight truncation, but it does not show any.

Cosmarium crenatum, Ralfs.

Fig. 15.

If Ralfs' figure 7, pl. xv., be correct, our New Zealand form differs from the English one by having its ends (as my figure shows) straight, without crenations. I think also that the segments are somewhat wider at the base. Length of frond 30·5 μ; breadth 27 μ.

Cosmarium botrytis, Bory.

In examining this plant I have been able to detect a very decided voluntary motion, which on one occasion I observed for nearly three hours. As far as I can gather from works available to me, it has never been satisfactorily shown that the Desmidieæ travel voluntarily, that is, in the manner in which Diatoms travel. It has long been known that Desmids "move;" that is, they will come to the surface if buried in mud, or to the side of a vessel nearest to the light. But such movements as these, as Ralfs remarks (p. 22), may be due rather to the stimulus of light than to "voluntary

effort." Many observers have recorded notes on this subject. Ralfs quotes the following:—"It was impossible to determine whether the vague motions of *Closterium* were voluntary or not" (Dalrymple):—"I have seen *Euastrum margaritiferum* move quite distinctly" (Bailey):—"Elles n'ont pas un mouvement sensible sur le porte-objet du microscope" (Brébisson)—contradictory assertions evidently. Mr. Archer (in Pritch. Inf., p. 5) says that "the Desmidieæ are seen to move. * * * * This phenomenon is most notable in *Closterium*; in others it is scarcely, in many not at all, cognizable." The Rev. Mr. Osborne, in the Journ. of the Micros. Soc., ii., 235, attributes the movements of *Closteria* to *cilia*, but no other observer seems to agree with his views. A friend of mine tells me that he has frequently seen *Cl. lunula* "rolling over and over." But none of these statements appear to me to satisfactorily settle the question whether the Desmids do voluntarily travel, in any willed direction, as the Diatoms do, or whether the movements observed may not have been due to some currents in the water or disturbing influences beyond the field of the microscope at the moment. I venture, therefore, to give a few notes of the motions observed by me in *Cosmarium botrytis*, motions which I believe to have been perfectly "voluntary," and not due to any external influences.

I had been observing the plant on a morning during the present spring, and comparing it with some specimens in my English gatherings. The specimen under observation was situated in the centre of my "field," in a small clear space between a *dead Pinnularia* and a small speck of dirt. It had been stationary for quite an hour, and there was no appearance during that time of any "swarming" within it. The day was fine, and an even full light came through the diaphragm. All at once I detected a commencement of "swarming," quite faint at first; and when this had continued two or three minutes, I observed a slight oscillation of the frond. By degrees the oscillation increased, and the Desmid began clearly to move from its place. Soon the motion increased, and the plant steadily worked its way out between the *Pinnularia* and the dirt, not gliding straight-forward but jerking along, with a motion exactly like that of a man elbowing his way through a crowd, pushing forward first one side and then the other. It was clear that the *Pinnularia* could not produce any effect on it, as it was dead; and I carefully looked to see whether anything in its neighbourhood could have set a current in motion, but found nothing. In about ten minutes the *Cosmarium* had jerked or elbowed itself out into the open water, and still continued its journey towards the *apparent lower* edge of the slide. Five minutes after, the "swarming" somewhat increased, as did also the oscillation; and the plant then stopped and began (also in jerks)

to raise itself on end, an operation which it took four minutes to complete. Having attained an upright position it remained there two minutes, waving gently to and fro, and then, all of a sudden, fell over on the other side. The "swarming" had now become quite violent, and the plant recommenced its travels, but this time in the contrary direction, returning towards the *Pinnularia;* after continuing thus for a minute or two it stopped, and then once more travelled away again. For half an hour it continued these manœuvres, sometimes going one way, sometimes another, always "elbowing" its way along, and in the main getting farther away from its original spot. Sometimes, when it stopped, it would roll about from side to side rather violently (but never from end to end). I thought I observed that as the "swarming" increased, so also did the "jerks," and it appeared to me also that the endochrome was changing. It showed a tendency to form in each segment two masses of closer consistency than the rest; each of these masses, retaining its bright green colour, became surrounded with a brownish band, and it was in this band (never in the green particles) that the swarming was conspicuous. Once an exceedingly minute Infusorium, scarcely visible under the $\frac{1}{8}$ objective, came sailing towards the plant, somewhat leisurely; but, when almost on the point of touching it, darted suddenly back to some distance. Was it repelled? I could not say: it did not return.

The oscillations and rollings of the *Cosmarium* continued for two or three hours, and I observed that whenever it chanced to come to any little mass of weed or dirt obstructing its course it avoided it, sometimes indeed retracing its steps a little to get round a headland. Whenever it raised itself on end I took especial pains to see whether anything could be observed of the nature of cilia, or whether any appearance could be detected in the water leading to the supposition that retractile processes existed, but without success.

I have no doubt that the movements described were quite as "voluntary," as those of any Diatom. In another part of the same slide a *Stauroneis* was travelling very actively and the difference between the two plants was that the Diatom glided backwards and forwards without more than very slight oscillation, whereas the *Cosmarium* made its way simply by lateral jerkings.

Staurastrum gracile, Ralfs.

Fig. 17.

This is another of the plants in which the differences from the European form do not seem to me to be sufficient to render it distinct. As my figure shows, it is less slender and the processes are shorter than in Ralfs' species. Length in end view from the middle of one side to the end of the opposite process (exclusive of the four spines) 50 μ: length of process 15 μ.

Staurastrum avicula, Brébisson.

Mr. Archer thinks that our plant may be a distinct form and says that Ralfs' figure of the English species is incorrect. I am willing to accept this, but as I have not seen any specimens since writing my former paper I am not prepared to suggest any new name.

All these minute forms of *Staurastrum* are difficult of identification and it would be easy to multiply species upon the slight differences occurring so frequently.

Didymocladon stella, mihi.

This plant must, I suppose, be relegated to the genus *Staurastrum*, as Pritchard, Rabenhorst and succeeding writers do not admit Ralfs' genus.

As to its specific status, I am in some doubt. After carefully comparing it with specimens of *S. furcigerum*, both from Hawke's Bay and from England, and allowing for Rabenhorst's statement that *S. furcigerum* may have from three to nine rays in end view, I cannot regard my *S. (Didymocladon) stella* as identical with that plant. In all my specimens of *S. furcigerum*, as remarked in the first part of this paper, whether there are five or six rays, those rays which are behind the terminal ones, and which are at first sight out of focus, are always in almost, if not quite, direct correspondence of direction with the terminal rays. I cannot see how in any case the peculiar multi-radiate appearance of *S. stella* can be produced by the English plant.

I find, however, in the "Midland Naturalist," a figure (vol. iv., pl. v.) of *Staurastrum arctiscon*, Ehrenberg, a plant mentioned by Rabenhorst as American, under the name *Xanthidium arctiscon*, and seemingly found lately in Wales. This plant, in end view, has six terminal rays, and eight others behind them, *almost* in corresponding directions. Whether, in some cases, it may show the twenty-eight divaricating rays of my *S. stella* I cannot say: if so, my plant will have to be abandoned as a distinct species.

S. pseudo-furcigerum, Reinsch, though its side view approaches best to that of *S. stella*, differs altogether in end view, being then more like *S. eustephanum* in general outline.

I find that Mr. Archer would refer our plant rather to *Staurastrum sexangulare*, Bulnheim, which I do not know.

Docidium baculum, Ehrenberg.

I expressed in my former paper doubts as to the existence of this plant here, and after comparison with English specimens I have come to the conclusion that it is not found here, or at least that it has not come under my notice. Its distinctive character is the possession of a *solitary*, prominent inflation at the base of each segment. All my New Zealand specimens show at least more than one inflation.

Closterium selenæum, mihi.

Fig. 19.

Two of the distinguishing marks separating this plant from *C. ehrenbergii* are—the acuteness of the ends and the absence of a median inflation of the inner margin. The first character is constant and conspicuous. With regard to the second, I find that although, in its natural state, the inner margin forms a clear concave curve, yet in all the preserving fluids which I have tried an inflation becomes noticeable; not indeed such an inflation as that of *C. ehrenbergii*, but of the nature of that shown in my figure, where the inner margin becomes nearly straight. Indeed, in glycerine, it is sometimes quite straight.

I find also that when fronds are about to *conjugate*, an inflation is noticeable on both the outer and the inner margin, but *only* in the immediate region where the suture should be; that is, the cell-wall *at that particular spot* is bulged out all round. This, which is part of the process of conjugation, as I am about to describe, is quite different from the wide inflation visible in *C. ehrenbergii*.

The process of conjugation, however, as I have lately been fortunate enough to see up to a certain point, is the same as in *C. ehrenbergii*, as described by the Rev. W. Smith, in the Annals and Mag. of Nat. Hist., 1850, p. 1, and pl. i. Two fronds, each of which presents the slight bulging at the middle just mentioned, approach each other, and then become surrounded by a mucous envelope, within which they lie, longitudinally approximate, their ends almost touching, and their concave sides turned towards each other. Next, they proceed to undergo *self-division*: each frond separates at the middle, drawing itself out until, after the separation, there appear *four* fronds, each with one long arm and one very short arm, the latter terminating in a rounded short beak. Then the conjugation takes place by the junction of each corresponding pair, the junction being operated at the point where the bases of the long and short arms occur: and the endochrome, pouring out from each frond and joining in the middle, forms the zygospore, or, rather, the *two* zygospores, as there is one to each pair. Unfortunately, I cannot say precisely the nature of these zygospores. The specimens which I observed had been placed in a growing-cell, where the process just described had been going on quite smoothly for more than twenty-four hours, from the first approach of the fronds down to the junction of the endochrome. At this point a sudden jar displaced the thin cover-glass of the cell: the conjugating fronds were crushed, and the process was at once brought to an untimely end. However, from what I saw, and from the presence in the gathering of bodies not otherwise identifiable, I have no doubt that the zygospores of *C. selenæum* are orbicular and smooth.

Mr. Smith (*loc. cit.*) says that *Closterium ehrenbergii* stands alone amongst the European *Closteria* in producing double zygospores. It is, therefore, not uninteresting to have to add to it in this respect a plant from New Zealand. But I have some doubt whether Mr. Smith's statement is altogether correct, in view of a noticeable feature in the conjugation of the next plant on my list, which affords, I think, foundation for a closer study of the phenomenon in connection with other plants of the genus. As a rule the conjugation of *Closterium* is, in a sense, simple enough: two fronds approach, join, open at a suture, and a zygospore is formed between them. If, as in *C. rostratum*, the fronds open at the *median* suture, the segments attached to the zygospore will be equal in length: should there be *secondary* sutures as in *C. intermedium*, the fronds may open at these and the segments will be unequal, but the inequality will be easily intelligible. In the case of

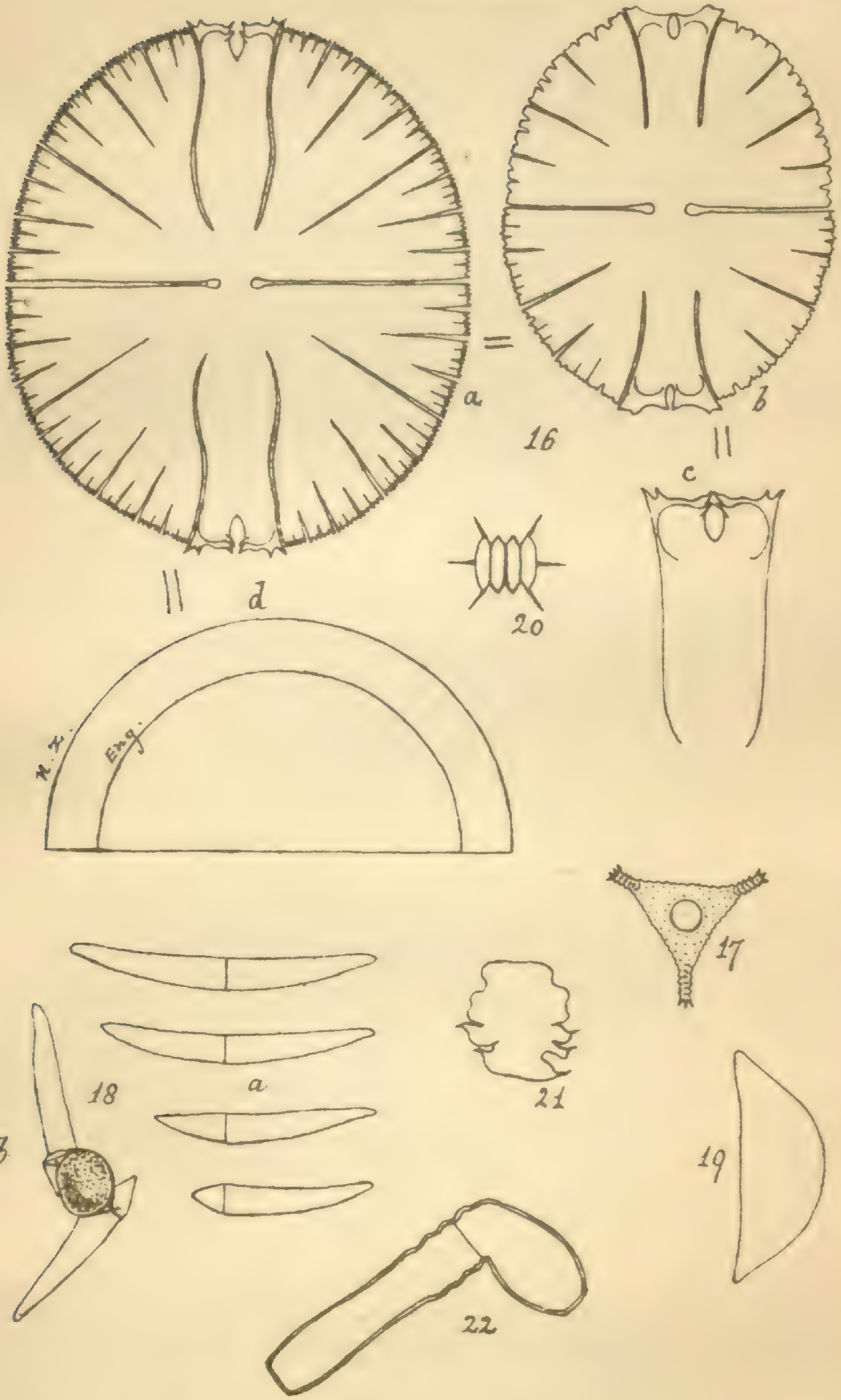
C. acerosum, Schrank,

Fig. 18.

the process, to a certain extent, resembles that in *C. selenæum*. That is to say, the segments attached to the zygospore are unequal, *although there are no secondary sutures.* The inequality is shown in my figure 18 *b*, where each frond has one long arm and one very short one. This inequality is also shown in Ralfs' plate xxvii, but no reference is made to it in the text. Mr. Archer, in Pritchard's "Infusoria," likewise says nothing of it. Von Siebold, in the Journal of the Micros. Society, 1853, seems to refer to something of the kind, though I do not understand his expression: he speaks of "only the two upper and lower halves" coalescing, a phrase which may mean anything.

In the spring of last year I gathered on one occasion a small quantity of *C. acerosum* in conjugation. Although unable to watch the process from its commencement, I examined the gathering with great care. There must have been several hundreds of plants in it, and they were all surrounded with a common mucous envelope, and not segregated in pairs as in *C. selenæum*. When the mass was first placed on the slide many of the fronds were already in full conjugation, and many others had completed the process. A small proportion (less than one in ten), presented the normal form of the plant, with two equal arms, as in my figure 18 *a*, the uppermost figure. A few more appeared as the second shown in fig. 18 *a*, and the rest had still shorter arms, the greater number of all being as in my lowest figure, with one arm almost an equilateral triangle. Conjugation *invariably* occurred between two fronds of this last form, *never* in any of the others.

If, in the conjugating fronds, I had detected any folds or wrinkles in the cell-wall of the shorter arms, I could have concluded that in the process that arm, for some reason or other, shrank up. But no such folds were



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NEW ZEALAND DESMIDIEÆ

visible in any case, beyond, that is, the folds due to the bursting of the cell-wall, which were easily recognizable. Consequently, I could only infer that the fronds had undergone self-division previous to conjugation; and on this supposition those in which the inequality was but slight would have simply missed conjugation and were growing in the ordinary way. This being the case, if I am right, it results that each pair of *segments* in *C. acerosum* produces a zygospore, and therefore each whole frond produces two zygospores; but the process differs from that of *C. selenæum* and *C. ehrenbergii* in this, that the fronds do not shut themselves up in pairs in mucus, but are all enveloped in the same envelope.

Certainly, I cannot say that I saw any fronds *dividing*, for the process had already begun, and was in full swing when first seen. But I am unable to account in any other way for the curious inequality of the arms.

As *C. acerosum* has only a suture at the middle, and no secondary sutures, the bursting of the cell-wall anywhere but at the middle cannot be explained as in *C. intermedium*. *Penium margaritaceum* and other plants also open unequally, but they too have secondary sutures.

Closterium lineatum, Ehrenberg.

This is another of the plants observed conjugating. There is nothing to distinguish it from the English species.

Closterium dianæ, Ehrenberg.

Also observed conjugating.

I add a figure (20) of *Scenedesmus quadricauda*, to show the three bristles sometimes observable.

Also two figures, 21 and 22, as specimens of the curious monstrosities of growth often seen amongst Desmidieæ, a family generally of such remarkable symmetry of form. Fig. 21 is *Tetrachastrum* (*Holocystis*) *incisum*; fig. 22 is *Docidium clavatum*.

NOMINAL LIST OF DESMIDIEÆ REPORTED FROM NEW ZEALAND UP TO 1882.

AN asterisk in this list marks the species described by me *as new* in the foregoing and my previous paper (vol. xiii., 1880, p. 297); a dagger marks those described *as new* by Dr. Spencer in his paper (vol. xiv., pp. 295, 296); and a double dagger those reported by Dr. Spencer in the same paper, but not new.

[NOTE.—I include also *Docidium* (*Pleurotænium*) *ovatum*, of which I find the following notice in one of Professor Nordstedt's papers—"Hæc species quoque in Brasiliâ et Novâ Zealandiâ lecta est;" but I do not know the plant.]

Hyalotheca dissiliens.
 dubia.††
Aptogonum undulatum.*
Desmidium aptogonium.
 swartzii.

Sphærozosma excavatum.
 filiforme.
 pulchrum.††
 vertebratum.
Micrasterias ampullacea.*

Micrasterias ampullacea, *var.* β †
denticulata ?
rotata.
thomasiana ?
Tetrachastrum (Holocystis) incisum.
Euastrum ansatum.
elegans.
Cosmarium botrytis.
broomeii.
crenatum.
cucumis. † †
cyclicum, *var.* ampliatum.*
gemmiferum.
granatum.
margaritiferum.
meneghinii.
moniliferum.
obsoletum, *var.* punctatum.*
ornatum ?
phaseolus.
punctulatum.
pusillum.
pyramidatum.
ralfsii.
„ *var.* β *
speciosum, *var.* inflatum. *
tenue. *
tetraophthalmum. † †
„ *var.* β.
thwaitesii ?
undulatum.
„ *var.* β *
sp. †
Xanthidium aculeatum.
cristatum.
Arthrodesmus convergens.
incus.
Staurastrum aculeatum.
alternans.
avicula.
clepsydra. *
cuspidatum.
dejectum.
dilatatum.
eustephanum, *var.* emarginatum. *
furcigerum.
Staurastrum gracile.
muticum.
orbiculare.
paradoxum. † †
polymorphum.
punctulatum.
spinosum.
(Didymocladon) stella. *
tetracerum.
tricorne.
sp. †
Penium brebissonii ?
closterioides.
digitus.
jenneri ?
margaritaceum.
Docidium clavatum.
dilatatum. ||
ehrenbergii.
ovatum (*teste* Nordstedt).
truncatum.
Triploceras tridentatum. *
„ *var.* cylindricum.*
Closterium acerosum.
acutum.
„ *var.* tenerrimum. † †
attenuatum. † †
cornu. † †
dianæ.
didymotocum.
ehrenbergii.
griffithii.
jenneri. † †
juncidum.
lanceolatum. † †
leibleinii.
lineatum.
lunula.
moniliferum. †
rostratum.
selenæum. *
setaceum.
striolatum.
venus.
Spirotænia condensata.
obscura.

|| *Docidium dilatatum* will have to be eliminated if it is really *D. ovatum.*

Ankistrodesmus acutissimus.	Scenedesmus acutus.
falcatus.	,, *var.* dimorphus.
sp. *	obliquus.
sp. *	obtusus.

DESCRIPTION OF PLATES XXIV. AND XXV.

Fig. 1.	Cosmarium ralfsii, *var.* β.	×	350.
,, 2.	Cosmarium thwaitesii	×	700.
,, 3.	Cosmarium pusillum, dividing	×	1.000.
,, 4.	Cosmarium gemmiferum (*a*, front view × 350 : *b*, end view × 400)		
,, 5.	Cosmarium obsoletum, *var.* punctatum (*a*, front view : *b*, end view)	×	350.
,, 6.	Cosmarium speciosum, *var.* inflatum (*a*, front view : *b*, side view)	×	450.
,, 7.	Cosmarium cyclicum, *var.* ampliatum (*a*, front view : *b*, end view)	×	350.
,, 8.	Cosmarium tetraophthalmum, *var.* β (*a*, conjugation with zygospore : *b*, front view : *c*, end view)	×	350.
,, 9.	Cosmarium undulatum, *var.* β	×	700.
,, 10.	Cosmarium tenue (*a*, front view : *b*, end view)	×	700.
,, 11.	Staurastrum eustephanum, *var.* emarginatum (*a*, side view : *b*, end view)	×	700.
,, 12.	Staurastrum clepsydra (*a*, *b*, side view : *c*, *d*, *e*, *f*, end view : *g*, zygospore ?)	×	400.
,, 13.	Staurastrum furcigerum (*a*, 5-rayed : *b*, 6-rayed)	×	350.
,, 14.	Closterium griffithii, two sizes	×	400.
,, 15.	Cosmarium crenatum, N.Z. form	×	400.
,, 16.	Micrasterias rotata, N.Z. forms (*a*, sharp teeth : *b*, truncate teeth : *c*, end lobe × 350 : *d*, comparative sizes N.Z. and English forms)	×	200.
,, 17.	Staurastrum gracile, N.Z. form	×	400.
,, 18.	Closterium acerosum (*a*, fronds with varying arms : *b*, the same with zygospore)	×	90.
,, 19.	Closterium selenæum, effect of glycerine	×	60.
,, 20.	Scenedesums acutus	×	400.
,, 21.	Holocystis (Tetrachastrum) incisa, abnormal	×	200.
,, 22.	Docidium clavatum, abnormal	×	90.

Art. XXXII.—*On a new Composite Plant.* By Robert Brown. Communicated by Professor Hutton.

[*Read before the Philosophical Institute of Canterbury, 30th November*, 1882.]

Glossogyne (?) *hennedyi*, sp. nov.

Plant a small excessively and irregularly branched under-shrub, from 6 to 12 inches high. *Stem* short, terete ; bark pale brown ; upper branches very slender, tetragonous, furrowed, bright green, hispid with stiff hairs. *Leaves* alternate, distant, from ¼ to ⅓ inch in length, sessile, linear-acute or sub-spathulate, entire or bi- or tridentate, midrib pellucid ; under surface with short stiff hairs ; upper or bract leaves linear-lanceolate, acute, small. *Flower heads* yellow ⅜ inch in diameter, single, terminal on the end of a short peduncle ; receptacle conical, chaffy. *Involucre* campanulate : bracts equal, in two rows, the outer linear, blunt, with a tuft of rigid hairs at the

apex ; the inner narrower, linear-lanceolate, acute : all the bracts hispid on the back. *Florets* of the ray female, ligulate, acute, recurved ; style slender, inclined, stigma linear, bifid, rounded at the apex, minutely papillose. Florets of the disc tubular, from two to ten, hermaphrodite ; corolla five-lobed hispid at the spreading and slightly recurved apex ; style shorter and stouter than in the ligulate florets, the stigma strongly papillose, bifid, linear, blunt at the apex ; stamens five, inserted on the corolla, filaments free, shorter than the anthers, anthers scarcely cohering, obtuse at the base and without any terminal appendage ; pappus of six to eight irregular awns, two or three of which are long and spreading, the others very short. There are always either three or five patent awns on one of the angles, and of these the centre one is longer than the others. All the awns are slightly confluent at the base and all are barbed with retrorse, single-celled, stiff hairs. *Achenes* sub-tetragonous, obconic, slightly compressed, hispid, with two of the angles minutely winged ; very persistent on the receptacle.

Glossogyne hennedyi, Brown, nat. size.

Hab. Godley Head, Banks Peninsula; on clay soil facing the north. Flowering from September to March.

This species differs from *Glossogyne* in the short peduncles, the rounded apex of the stigma ; the obconic achenes, and greater number of awns, as well as their peculiar arrangement. I have named it after Mr. Roger Hennedy, lecturer on botany at Andersonian University, Glasgow, my former teacher.

ART. XXXIII.—*Further Notes on* Sorghum *Experiments*.

By MR. JUSTICE GILLIES.

[*Read before the Auckland Institute, 31st July*, 1882.]

ON the 8th of August last I had the honour to present to this society some notes on the growth of *Sorghum** in this district, meaning by this district the volcanic soil on which I live at Epsom, close to the base of the old volcanic crater of Mount Eden. In such light and poor though quick soil, I did not expect the *Sorghum saccharatum* to develope its full capacity of growth, nor did I in the moist climate of this Isthmus of Auckland expect it to develope to the full extent its saccharine properties. On that occasion, however, I proved that even on such soil not manured, I had produced at the rate of 6·2 tons per acre of topped but unstripped cane of the Early Amber *Sorghum*. My experiments this year show me that this was equal to about 5·25 tons of topped and stripped cane ready for crushing.

I now proceed to give my experiments of this year. First as to the growth of the cane.

From circumstances over which I had no control, I was able this year to grow and cultivate properly only one quarter of an acre of the Early Amber from American seed. It was grown on the same soil on which I had raised last year's crop, but I gave it chemical manure in accordance (as nearly as I could obtain the ingredients here) with M. Georges Villes' formula (on Artificial Manures, Crookes' translation, 1879, p. 396) for Sorgho. I planted in the second week of November (a little too late I think), in drills 3 feet apart, with about 4 seeds 2 feet 6 inches apart in the drill. Absence from home prevented my noting the various stages of growth, but it was ready for cutting, *i.e.* the seed was ripening, in the second week of April. As you are aware, the season was an exceptionally wet and cold one, which no doubt interfered materially both with its growth and ripening. In the second week of April I cut, topped, and stripped a ton and a half weighed, leaving fully as much more standing for cattle-feed. This gives a yield of 12 tons per acre of topped and stripped cane, or considerably more than double what I obtained from the same ground on the previous year. Some of my own seed of the previous year which I had sown broadcast showed much stronger and heavier, but I had no means of accurately estimating the difference. I had in spring distributed a large quantity of both American and New Zealand grown seed, and so far as I have heard the New Zealand grown seed produced the heaviest crop.

Mr. Joseph Banks, of Meadowbank Farm, Tamaki, planted in November after taking up a crop of potatoes, and grew a crop of 20 tons of topped but

* Trans. N.Z. Inst., vol. xiv., p. 373.

unstripped cane to the acre, equal to 17 tons of stripped cane ready for crushing. On two tons of this I experimented, as I shall afterwards describe.

Mr. William Johns, writing on 28th March, 1882, reports to me as follows regarding the growth of Early Amber Sorghum at Te Rahu, near Te Awamutu:—"On the 25th of October, 1881, I planted out the greater portion of a packet of seed of the above received from you through Mr. Lavers.

"It was planted on fair land, manured with bone-flour at the rate of about 5 cwt. per acre. The seed grew well until the plants were some 3 inches high, when unfortunately, on account probably of its being planted alongside a plat of maize, which shared its fate, nearly every plant was pulled up by the pheasants.

"Having fortunately a little seed left (about 1 oz.), I replanted a portion of the ground on the 15th November, sowing—as before—the seed about 2 inches deep, about 3 feet apart in the rows and about the same distance between each hill, 5 or 6 seeds to each hill. This seed grew very rapidly undisturbed by the pheasants; the time at which it was planted being, in my opinion, more suitable than earlier in the season.

"By the latter end of January the canes began to form and on the 20th of February the first flower-top appeared, being considerably later than what I expected; but the ground having a slight southerly aspect may account for this. By the end of February the flowers had become well developed, the canes at this time being 8 to 9 feet high. At the present time (28th March) the seeds are well ripened, the amount of seed which I estimate to save being about half a bushel (20 to 30 lbs.), portions of which I intend to distribute among my neighbours, so that its growth here in Waikato may be well tested.

"Judging by the growth of the small plat I have, I estimate the weight of cane that could be grown on an acre at from 15 to 20 tons at the least, from which I should say about a ton of seed could be obtained.

"Not wishing to interfere with the growth of the seed, I did not cut any of the canes for the purpose of expressing the juice, save a few only by way of experiment, from which I am led to believe—first, that the very large and the very small canes yield comparatively poor saccharine juice; and second, that medium-sized canes, of say three-quarters of an inch in diameter at their lowest joint, are far the richest in that respect; as a rule those exceeding an inch and those under two-thirds of an inch respectively at their lower joints, do not equal those that vary within those two measures in richness of juice.

"I think, therefore, that to obtain plants rich in sugar, while the seeds should be planted in rows 3 feet apart, the hills should not be more than 2 feet apart, with 3 to 4 seeds in each hill; this would tend to encourage the growth of moderate-sized canes rich in sugar. From a farming point of view I should say the Sorghum should be a very useful fodder plant, coming in when pastures are generally parched up; and, as it can be sown late, land under turnips in winter can easily be prepared for it late in spring, when the turnips are eaten off. While, should only the sugar be successfully extracted from it, it is a plant that will evidently thrive admirably on the alluvial loams of the Waikato District.

"In growing the above I purposely tried it on land of only ordinary quality and with ordinary treatment, thinking it a fairer test than by forcing the plants on extra rich soil."

Mr. W. Tetley of Paeroa reports to Mr. Lavers as follows:—"The Sorghum (grown from the two parcels of seed which you kindly sent me, off that which Mr. Justice Gillies had in such a public-spirited manner placed at your disposal) was planted on the 1st and 2nd November. It grew to a height of from 10 feet 6 inches to 12 feet.

"I planted it on a plat of ground which I considered too wet to grow potatoes, and the season has been rather unfavourable, otherwise I think it would have grown considerably higher and heavier.

"The weight of cane produced per acre of Honduras and Early Amber (cut as directed, and stripped of leaves) was 13 tons 5 cwt. and 18 tons 3 cwt. respectively.

"From 1 cwt. of the cane we pressed (with a very indifferent machine) 6 qts. 1·86 pts. of juice, one gallon of which weighed 10 lbs. 2 oz., and yielded 2 lbs. of treacle.

"The quantity of juice to the acre will therefore be about 460 gals. from the Honduras, and 630 gals. from the Early Amber, or 920 lbs. and 1,260 lbs. of treacle to the acre respectively."

Mr. S. Meiklejohn, of Matakana, is reported as follows in the newspapers:—"From Mr. S. Meiklejohn, Matakana, we have received a sample of syrup made from Sorghum grown upon his farm this season. He states that he got some seed from Mr. Justice Gillies, through Mr. Lavers, Queen-street, and that he planted it on land which produced four tons of potatoes to the acre. He sowed it in drills three feet apart, and it grew to the height of eight to ten feet. He believes it should be planted in drills not less than six feet apart. When beginning to seed he crushed sufficient cane to produce 35 gallons of juice, which he boiled down to 4 gallons. When the cane was fully ripe he crushed sufficient to yield 10 gallons of juice, and got 17 lbs. of syrup or molasses, a sample of which he has sent to us. The

syrup is very good, and would doubtless be very suitable in a family where there is a number of children. It is free from any unpleasant flavour, and had it been properly treated for sugar-production would no doubt have yielded more or less dry sugar. Mr. Meiklejohn is of opinion that there would be no difficulty in growing a crop that would yield from 120 to 150 gallons per acre, a quantity which we think is considerably under-estimated. With power of some kind to drive the crusher, he believes a crop of Sorghum could be grown and harvested with less risk and trouble than a crop of oats. He has found the seed to be valuable feed for fowls, and the strippings, or crushed canes, good cattle-food."

From my own experience, therefore, and the testimony thus afforded me, I think I am warranted in saying that on average land, properly cultivated, as for a crop of maize, a crop of Early Amber cane of 15 tons to the acre, topped and stripped, may be reasonably expected. On poor soils, or if not kept clean from weeds, or in unfavourable seasons, the yield may be less; on rich soil, well cultivated, and in favourable seasons, the yield may be much greater. So much for the growth of the plant. I now come to its economic value.

That it is eagerly eaten by cattle and horses in all stages of its growth, but more especially as it comes on towards ripening, I can speak from my own experience, as well as from the testimony of others. And, as Mr. Johns points out, it may be planted after turnips are fed off,—or, as Mr. Banks has proved, after an early crop of potatoes has been taken, and come in as green food for stock in March, when our Auckland pastures are much burnt up. If the cane is kept for syrup- or sugar-making, the seed is most valuable for fowls. This brings me to my experiments in syrup- and sugar-making during the past season.

And here I may say that these experiments, though not altogether successful, are at least instructive, and may lead up to better success in the future either by myself or others. The crushing-mill I used was a No. 0 Victor mill (the smallest size), manufactured by the Blymyer Manufacturing Company, Cincinnati, U.S.A., price $50 or £10. (With freight per rail and mail steamer, it cost me here £16 8s. 6d.) It has worked admirably, although I have not been able yet to get it to turn out what the makers say it can do, namely—40 gallons of juice per hour. The greatest quantity I have obtained was 21 gallons per hour; but this may be owing to the slow pace of the horses used. The boiler used was of copper, and was made in Auckland, 4·6 × 2·3 × 2·3, capacity gallons. The evaporator made in Auckland was of galvanized iron, 9 feet long × 3½ feet wide × 8 inches deep. The boiler I found well suited to the work, but the evaporator was not satisfactory. They cost respectively £7 and £4 10s.

On 6th April last I received from Mr. Joseph Banks two tons of Early Amber cane, topped, but unstripped. Although the seed had so far ripened that the birds had nearly stripped it, the cane and leaves were very green owing probably to the unusually moist and cold season. Next day I began my experiments. I weighed one stalk with leaves on, 1 lb. 5 oz., put it through the mill, when the dry residuum (or bagasse) weighed 9 oz., showing 57 per cent. of juice obtained. As the juice, however, was very green, I slacked the mill rollers a little and stripped the cane. An average of 12 canes stripped showed 10 lbs. weight or 13·3 oz. per cane. At a later stage of crushing I found 82 canes yielded 3 gallons of juice, weighing 11 lbs. per gallon or 6·44 oz. juice per cane. This is equal to 48·3 per cent. of juice to cane, but on the total crushing of one ton I actually realized only 41·25 per cent. or 84 gallons. This I crushed at the rate of 12 gallons per hour, but in my subsequent crushings, with a faster walking horse, I made 21 gallons per hour. The juice was caught from the mill in graduated galvanized iron buckets and poured at once into the boiler; it showed a density of 11 at a temperature of 66° F. The fresh juice did not affect blue litmus, but after standing for an hour or two in the boiler it made the litmus a deep indigo colour. The weather in the afternoon was very wet, and as I had no shelter for the canes, they were wet while passing through the mill, thereby to some slight extent affecting the juice. In consequence of the rain I did not proceed to boil and evaporate till next morning. I then found the juice from the top of the boiler weigh 10 lb. 10 oz. per gallon, owing no doubt to part of the solid matter having settled to the bottom. The litmus showed a blue purple colour. Having lit the fire (of Kamo coal) I kept the juice constantly skimmed throughout the whole process. When the thermometer indicated 150° F., I added about one quart of cream of lime, stirring it well into the juice. My impression now is that I added too much lime, and that it was not of proper quality. I could not obtain pure shell lime, and had to use Mahurangi hydraulic lime, recently slaked, which I found by another experiment rendered the juice acrid. One hour and a quarter from the fire being lit, the juice was boiling. Having allowed it to boil for a few minutes, I drew the fire and allowed the juice to settle. Having allowed sufficient time for that purpose, I began to draw off into the evaporator, but finding a good deal of sedimentary matter still in the juice, and my stopcocks not working properly, I was obliged to dip out the hot juice with buckets and strain it through a clean cornsack into the evaporator. It was then clear and of a dark amber colour. Not wishing to allow the temperature to get below 150° F., I did not take all the juice from the boiler, only about 50 to 55 gallons, and at once started the fire under the evaporator. I then added sulphurous acid until litmus began to redden.

I kept the juice in the evaporator constantly boiling till I found the thermometer indicate 220° F. as the boiling-point. The temperature, however, must have been much higher, as the original boiling-point of the juice indicated only 210°, and I subsequently found that my thermometers could not be relied upon at those high temperatures. As soon as 220° was indicated I drew the fire, but the syrup, which had then thickened very rapidly, continued for a long time in a state of ebullition. All the time of evaporating I kept the juice stirred with wooden paddles to prevent burning, but, in spite of all my care, a portion of the syrup got burnt. As soon as possible I ladled out the syrup, which was now of the consistence of thick treacle, into a 25-gallon cask, and found that I had about 10 gallons of syrup of a rich brown colour. The cask I placed in a room with a fire to keep the temperature up to 80°, the atmospheric temperature being only 66°. Next morning I found one of the hoops had slipped, and treacle was oozing through between some of the staves. For several days the heat was kept up to 80° to 84°, but, there being no sign of crystallization, I drew off the treacle, of which there were about 5 gallons, the remainder seeming to be a yellowish treacle in a frothy condition. I have since been informed that this was saccharate of lime.

On the 10th April I tried a second experiment with the balance of Mr. Banks' cane supplemented by sufficient of my own to make up a ton. This we crushed at the rate of 21 gallons per hour. The fresh juice weighed 11·5 lbs. per gallon, showing a density of 12 at a temperature of 68° F. Obtained 80 gallons of juice from the ton, but, in the boiling, just after adding the lime, the whole thing suddenly boiled over and was destroyed. The cause I cannot tell, unless it may be connected with the state of the juice from Mr. Banks' cane, which had lain exposed to heavy rain for three days.

On the 11th I again crushed a ton of cane. This was of my own growing, fresh cut, and much riper than the former cane used. From it I obtained 78 gallons of juice, showing a density of 13·5 at a temperature of 62° F. This I boiled as before, but on this occasion used pure shell lime, which gave a much better result in clearing the juice, so that, when it came into the evaporator, it was a light amber colour. Added sulphurous acid as before to neutralize excess of lime, and continued evaporating carefully to avoid burning until the syrup had obtained, as I thought, a sufficient density—as I could not trust my thermometers. When it cooled, however, I found it had not been sufficiently evaporated, so that on this occasion also I failed to produce a crystallizable syrup. My public duties prevented my further experimenting during the past season. I may here mention, however, that Mr. Skey, the Government Analyist, in the month

of May analyzed a portion of my crop, then still standing, and found it produce 7·12 per cent. of sugar, of which a very small proportion was uncrystallizable. I hope that the teachings of my failures will enable me to be more successful next year.

But I have succeeded in making sugar. A portion of the treacle made from my first crushing I distributed, and a portion was used for household purposes. About 2½ gallons were put into an earthenware jar, and left in a storeroom. On looking at this jar some two months after, I found a deposit of crystallized sugar an inch thick all over the sides and bottom of the jar. This I took and strained through a sieve under pressure and obtained about 5 lbs. of sugar.

Of the quality you can judge for yourselves from the samples I now place before you. It is, I believe, the first sugar produced in New Zealand. I also present you with samples of the treacle.

Summary of results proved by experiments.

1. That from 12 to 18 tons of topped and stripped cane per acre can be produced on average soils with ordinary culture.
2. That 50 per cent. of the weight of stripped cane can be expressed. I have averaged over 41 per cent. on 3 tons,—or 80·66 gallons.
3. That the juice averages over 11 lbs. per gallon, weight.
4. That the juice must be evaporated to one-fifth of its bulk to produce a crystallizable syrup.
5. That the main difficulties are the evaporation and crystallization.

ART. XXXIV.—*On the Growth of the Cork Oak in Auckland.*

By Mr. Justice GILLIES.

[Read before the Auckland Institute, 28th August, 1882.]

IN the public newspapers, and in the utterances of members of Parliamentary committees for the encouragement of native industries, we periodically find suggestions as to the introduction of the growth of the cork oak in New Zealand. The following facts may, therefore, be not uninteresting as affording data by which to judge of the economic value of the cork oak in New Zealand.

In the year 1855, the late Dr. Sinclair planted close to his house, near Symonds Street, a young cork oak, received from Kew. It is now about 40 feet in height, 14 feet from the ground to the first branch, with a spread of top of about 40 feet in diameter. The trunk at 3 feet from the ground is 5·8 ft. in circumference after stripping. For several years past it has produced acorns, from which the present occupant of the grounds,

Mr. John Hay, has raised a large number of young oaks, and distributed them liberally throughout New Zealand. In the summer of 1877 I stripped it for the first time, and got a large quantity of virgin cork, which I did not weigh, the first stripping being of little or no commercial value. In February last I again stripped it, and after drying the bark found the product to be 70 lbs. weight of good marketable cork, fit for pint corks, as I am informed by Mr. Dutton, the cork-cutter, who was present at the stripping, and states it to be worth at least 60s. per cwt.

It will thus be seen that the trees must be 25 to 27 years old before producing any return, and then every five years may produce 70 lbs. to 100 lbs. weight of marketable cork. The produce improves in quality by each stripping. On comparing the New Zealand product with the imported bark, it is evident that the annual growth of the bark in Auckland is quite equal to that of the import.

I present herewith to the museum a sheet of the cork of last stripping, 3 feet 4 inches by 1 foot 4 inches, which shows the character and quality of the cork, and is, I believe, the first produced in New Zealand. I also present a section of one of the branches, showing the mode of growth of the virgin cork.

Art. XXXV.—*The Naturalized Plants of the Auckland Provincial District.*

By T. F. Cheeseman, F.L.S., Curator of the Auckland Museum.

[*Read before the Auckland Institute, 30th November,* 1882.]

The wonderful rapidity with which plants alien to the New Zealand Flora have established themselves in this country, the rate at which they have spread through the length and breadth of the land, and the marked effect that they have produced and doubtless will continue to produce on the indigenous vegetation, are facts so patent that they cannot escape the notice of the most incurious person. And it is a remarkable circumstance that most of these plants are of European origin. A stranger landing at any one of the chief ports in the colony might almost fancy himself to be in a corner of the northern hemisphere, if the appearance of the vegetation were his only guide. The sturdy and irrepressible plants that occupy the waste places and roadsides of a European town meet him on his arrival here; the weeds of the pastures and meadows are mostly the same; the cultivated fields and gardens are invaded by the same unwelcome and troublesome intruders here as there. And when he comes to carry his observations further into the country, and makes acquaintance with its true flora, still he finds, however far he may extend his travels, that there is no corner,

remote and apparently inaccessible though it may be, into which some of these species of northern origin have not found their way, and thrust out a portion of the original possessors of the soil.

No part of New Zealand is better suited for studying this "replacement of species"—as it is aptly termed by Sir Joseph Hooker—than the district of Auckland. Possibly in portions of the Canterbury Plains the destruction of the native plants and the estabishment of foreign ones in their place may be more complete over large continuous areas than anywhere in Auckland; but this is a consequence of extensive cultivation, coupled with sameness of physical conditions, and the number of species naturalized is comparatively small. The mildness of the northern climate, warm and moist without being too hot, is not only favourable to the common weeds of Northern and Central Europe, some of which exhibit a luxuriance rarely seen in their native country, but allows many plants from warmer climes to become naturalized by their side, so that the total number of species introduced is large indeed. To mention one instance,—the little County of Eden, which includes simply the Auckland Isthmus, and cannot have a greater area than about 25,000 or 30,000 acres, supports nearly 350 naturalized plants, all of spontaneous origin, and maintaining themselves without direct assistance from man; or, as in most cases it would be more correct to say, in spite of his efforts to destroy them. This is a number almost identical with that of the indigenous species of Phænogams found in the same area.

The only attempt hitherto made to catalogue the naturalized plants of Auckland is that of Mr. Kirk, in the Transactions of the New Zealand Institute, vol. ii. In a valuable paper, entitled "On the Naturalized Plants of New Zealand" (but which deals solely with those of Auckland), he enumerates 292 species. From this number, however, it appears to me that 31 must be struck out, either as being indigenous, or incorrectly introduced by previous writers on New Zealand botany, or as being now extinct. This would leave 261 as truly naturalized. In some subsequent papers Mr. Kirk adds a few additional species, raising the number to 283. In the appended catalogue I give the names of 387 species, with particulars of their distribution; 104 being recorded for the first time. I have taken some little trouble in collecting statistics respecting these 387 species, and it will be useful to give a brief abstract before proceeding to discuss why it is that so large a number of foreign plants have been able to establish themselves here and why they should have such an apparent advantage over the native flora.

First as to their origin. Naturalized plants as a rule have wide ranges, and are often found in an indigenous condition (so far as we can judge) over half a continent or more. Whether this is due to naturalizatiou at a remote

period through the agency of man, direct or indirect, or whether it is that in addition to possessing great flexibility of character and consequent power of adapting themselves to varied conditions, they have also been able to spread widely by natural means of migration, it is now for the most part impossible to say—probably both causes have operated. Their wide ranges, however, make it difficult to state their distribution with exactness, but the following will be found to be a sufficiently close approximation. 280 are natives of Europe, many of them also ranging into temperate Asia and North America, and some into North Africa, but for our purpose it is not important to specify these. 10 species, not European, are from the eastern portion of North America, and 4 are from the western side of the same continent. This will make a total of 294 species introduced from the north temperate zone. From Australia, notwithstanding its nearness to us, we have only received 10; from Chili and the cool portions of South America, 9; from the Cape of Good Hope, 21. The number naturalized from the south temperate zone is thus only 40. Finally, there are 53 species from the subtropical and tropical portions of both hemispheres, most having a very wide distribution.

With respect to the habit and duration of the species, only 31 are trees or shrubs, the remaining 356 being herbaceous. Of this latter number 176 are annual, 28 biennial, 152 perennial. The large proportion of annual species is noteworthy, as in the indigenous flora nearly all the herbaceous plants are of perennial growth.

If it is endeavoured to divide the species into groups according to the nature of their habitats, it will be found that nearly two-thirds fall, in about equal numbers, into three classes: first, weeds of cultivated lands and gardens; second, inhabitants of meadows or fields; third, plants of road-sides or waste places. Of the remaining third a considerable proportion are escapes from gardens, or other plants whose position it is difficult to define at present, and which occupy very various stations: littoral, paludal, sylvestral, etc.

Finally, we find that the species belong to 233 genera, arranged in 60 orders. The orders best represented are,—*Gramineæ*, with 60 species, *Compositæ* 51, *Leguminosæ* 35, *Cruciferæ* 20, *Caryophylleæ* 15, *Rosaceæ* 14. Of the genera no less than 182 are without indigenous representatives in this country, and 16 of the orders are in the same position. The large number of genera into which the species are distributed shows that our naturalized flora is of a very diversified character; and the fact that most of the genera have no indigenous species, proves that naturalized plants, to succeed in any country, need not have any close affinity with the pre-existing inhabitants.

With the above facts before us, we are better able to enquire into the general subject of the naturalization of plants in New Zealand and to attempt an answer to the question why the native vegetation should apparently be unable to hold its own against the numerous intruders streaming in on every side. In considering the subject, it appears to me most important to bear constantly in mind that the conditions of plant-life now prevailing in New Zealand are in great measure different to those that existed when European voyagers first visited its shores. When Cook landed here the whole country was covered with a dense native vegetation, hardly interfered with by man. The cultivations of the Maoris were small in area, and as they rarely tilled the same plot of ground for many years in succession, preferring to abandon it when the soil showed signs of exhaustion and to make new clearings elsewhere, there was little chance of the establishment and gradual development of a race of indigenous weeds. In fact, it can be roundly said that the New Zealand Flora contained no such class. At that time there were no herbivorous animals of any kind, either wild or domesticated, to graze upon the vegetation, or to interfere with it in any way. Thus no check existed to the growth of many species which can now hardly live in a district where our introduced cattle are abundant. And the repeated burning off, year after year, of large tracts of open country, was then a circumstance almost unknown. The Maori rarely wantonly destroyed the vegetation, and if he used fire in making his new clearings generally took precautions that it should not spread further than was absolutely required. It is hardly necessary to dwell longer on this point; for all must admit that the advent of European settlers and the colonization of the country have brought into operation a set of conditions injurious to both the indigenous fauna and flora. The chief of these conditions may be conveniently grouped under three heads:—first, the actual destruction of the vegetation by the settlers to make room for their cultivations, or in the construction of roads, or in the cutting down of the forests for timber, etc., etc.:—second, the introduction of sheep, cattle and horses and their spread over the greater part of the country:—third, the practice, now very generally followed, of burning off the vegetation in the open districts at regular intervals.

If the above facts are duly considered there will not be so much cause for wonder in the introduction and rapid spread of so many foreign plants. For instance, it might be expected that the weeds of our corn-fields and pastures—which now form such an important and conspicuous element in the naturalized Flora—would be almost wholly composed of introductions from abroad. The native Flora possessed few plants suitable for the places they have taken, and these few could hardly compete with a chance of

success against species that have from time immemorial occupied the cultivations of man, and whose best adapted varieties have been rigorously selected. The introduced weeds flourish and multiply because they have an environment suited to them and to which they have been modified; the native ones fail because the conditions have become altogether different to those they had been accustomed to.

Similarly it was to be expected that foreign plants would in some degree displace the indigenous ones in districts grazed over but not actually cultivated. Many native species will not bear repeated cropping, and soon decrease in numbers when cattle or sheep are brought in. Their places will, therefore, be taken by plants that are indifferent to this, or escape by reason of being unpalatable. It hardly needs pointing out that many of our introduced species are in this category. The common thistle, for instance, is protected by its prickly leaves; the docks and buttercups, and many labiate plants, are rejected by stock, save when food is scarce, on account of their unpleasant taste; while most grasses and some leguminous plants may be eaten down repeatedly without suffering much permanent injury. It is obvious that these species would have a good chance of spreading if introduced into a district where sheep and cattle are numerous. At the same time it must be remembered that any native plants possessing similar advantages would also increase; and in many cases this has actually taken place. The spread of such indigenous plants as *Poa australis* and *Discaria* in the river valleys in the interior of Nelson and Canterbury; of *Cassinia* on the shores of Cook Straits; and of some grasses (as *Danthonia semiannularis* and *Microlæna stipoides*) in Auckland, are well-known examples, and it would be easy to enumerate more.

But although we may safely credit the changed conditions of plant-life with being a powerful reason for the spread of naturalized plants in New Zealand, it is impossible to consider it as the sole explanation. For we find that not a few species have penetrated into localities where cultivation and cattle are alike unknown, and where man himself is a rare visitant; where, in fact, the conditions are still unchanged. This is the most interesting part of the subject, for it proves conclusively, as remarked by Mr. Darwin, that the indigenous plants of any district are not necessarily those best suited for it. In most cases it is impossible to assign any obvious reason for the fact that these intruders should be able to thrust on one side the native vegetation; but it is significant that all, or nearly all, are common and widely distributed in their native countries; in short, are predominant species; and that they have followed almost everywhere the footsteps of man, being as extensively naturalized in many other countries as in New Zealand. We may, therefore, suppose that by long-continued

competition with other species, in different localities and in different climates, they have gained a vigour of constitution and a faculty of adapting themselves to a great variety of conditions which enable them to readily overcome plants that have not been so advantageously modified.

This supposition will also throw some light on the curious fact that the vast majority of our plants are of northern origin. It is now generally admitted by geologists that the present continents are of immense antiquity, and that there has been no great alteration in the relative proportions of land and water during vast geological epochs. Mr. Darwin therefore argues that as the northern hemisphere has probably always possessed the most extensive continuous land area, so the wonderfully aggressive and colonizing power of its plants at the present time is due to development where the competition of species has been the most severe and long continued, owing to the presence of facilities for natural migration. The plants of the comparatively isolated countries of the southern hemisphere have not been subjected to the same degree of competition, and consequently could not be so advantageously modified.

It is difficult to predict the ultimate result of the struggle between the invaders and the natives. Many naturalists believe that the foreign species will succeed in displacing and exterminating a large section of the indigenous flora. Mr. Travers, for instance, goes so far as to say*—" Such, in effect, is the activity with which the introduced plants are doing their work, that I believe if every human being were at once removed from the islands for even a limited number of years, looking at the matter from a geological point of view, the introduced would succeed in displacing the indigenous fauna and flora." Also, in his presidential address to the Wellington Philosophical Society,† he states :—" Indeed, I have no doubt, from the present comparative rarity of many plants which were formerly found in abundance in such districts " (the sub-alpine portions of Nelson), " that in a few years our only knowledge of them will be derived from the dried specimens in our herbaria." On the other hand, Mr. Kirk, who has paid special attention to the naturalization of plants in New Zealand, and whose views are therefore entitled to careful consideration, takes a much more hopeful view of the future of the native flora. In a paper on the naturalized plants of Port Nicholson,‡ he says :—" At length a turning-point is reached, the invaders lose a portion of their vigour and become less encroaching, while the indigenous plants find the struggle less severe and gradually recover a portion of their lost ground, the result being the gradual amalgamation of those kinds best adapted to hold their own in the

* Trans. N.Z. Inst., vol. ii., p. 312. † Trans. N.Z. Inst., vol. iv., p. 359.

‡ Trans. N.Z. Inst., vol. x., p. 363.

struggle for existence with the introduced forms, and the restriction of those less favourably adapted to habitats which afford them special advantages." Further on in the same article Mr. Kirk combats the view that the majority of our native plants will become extinct, stating that the particular species for which this danger is to be feared might almost be counted upon one's fingers.

My own views on this difficult question are much nearer to Mr. Kirk's than to those of Mr. Travers. I can certainly find little evidence in support of the opinion that a considerable proportion of the native flora will become extinct. Even in isolated localities of limited area, like Madeira and St. Helena, where there is little variety of climate and physical conditions, and where the native plants have been subjected to far more disadvantageous influences, and to a keener competition with introduced forms, than in New Zealand, the process of naturalization has not gone so far as to stamp out the whole of the indigenous vegetation, although great and remarkable changes have been effected, and many species have become extinct. I fail to see why it is assumed that a greater effect will be produced in New Zealand, with its diversified physical features and many varieties of soil, situation, and climate. Surely its far-stretching coast-line, bold cliffs, and extensive sand-dunes, its swamps and moorlands, its lofty mountains and wide-spreading forests, will afford numerous places of refuge for its plants until sufficient time has been allowed for the gradual development of varieties better suited to the changed conditions. No doubt some few species will become extinct; but these will be mostly plants whose distribution was local and confined even when Europeans first arrived here; and probably all will be species that have for some time been slowly tending towards extinction, and whose final exit has thus only been hastened. I cannot call to mind a single case of a plant known to be widely distributed when settlement commenced that is at present in any danger of extinction. Species have been banished from cultivated districts, of course, but they are still abundant in other situations, and probably there will always be a sufficient area of unoccupied and uncultivated lands to afford them a secure home.

Speaking generally, I am inclined to believe that the struggle between the naturalized and the native floras will result in a limitation of the range of the native species rather than in their actual extermination. We must be prepared to see many plants once common become comparatively rare, and possibly a limited number—I should not estimate it at more than a score or two—may altogether disappear, to be only known to us in the future by the dried specimens preserved in our museums.

Catalogue of Naturalized Plants observed in the Provincial District of Auckland.

(Those species not previously recorded are marked with an asterisk.)

RANUNCULACEÆ.

Ranunculus acris, L. Meadows in several localities, but not common. (Europe.)

,, *repens*, L. Damp pastures and waste places. Whangarei; vicinity of Auckland; Waikato district, etc. (Europe.)

* ,, *bulbosus*, L. Plentiful in meadows, by roadsides, etc., throughout the provincial district. (Europe.)

* ,, *hirsutus*, Curtis. (*R. philonotis*, Ehr.) Plentiful near Auckland, and in many of the country districts southwards to the Waikato. This species has increased very largely during the last five or six years. (Europe.)

,, *parviflorus*, L. Of common occurrence in pastures, and waste places. Auckland Isthmus; Thames; Coromandel; Waikato; etc. It must not be confounded with the *R. parviflorus* var. *australis* of the Handbook, which is indigenous in the Auckland district, and which to me appears to have good claims to rank as a distinct species. (Europe.)

* ,, *muricatus*, L. Local. Bay of Islands; waste places near Auckland; Onehunga. (Europe.)

,, *pusillus*, Poir. Recorded by Mr. Buchanan from the island of Kawau. I suspect some mistake, as the true *R. pusillus* is a North American plant, and not at all likely to occur in New Zealand. (N. America.)

* *Aquilegia vulgaris*, L. Occasionally seen as a garden escape, but is by no means common. (Europe.)

* *Nigella damascena*, L. A garden escape in light soils near Auckland. (S. Europe.) One or two species of the allied genus *Delphinium* are also frequently seen, but they do not permanently establish themselves.

PAPAVERACEÆ.

Papaver rhœas, L. Cultivated fields, not common. Mongonui; Auckland Isthmus; near Alexandra. (Europe.)

* ,, *somniferum*, L. A garden escape. Devonport; Ponsonby; etc. (Europe.)

Fumaria officinalis, L. Has become a troublesome weed in light soils in some parts of the Auckland Isthmus. (Europe.)

* *Eschscholtzia californica*, Cham. An escape from gardens in light dry soils. Devonport; Mt. Eden; covering the greater part of a field at Panmure in 1879. (California.)

CRUCIFERÆ.

Nasturtium officinale, Br. Now abundant in streams and swamps throughout the district, and attaining a size unknown in Europe. (Europe.)

Barbarea præcox, Br. This is frequently seen in all the settled districts, but is nowhere very plentiful. (Europe.)

Alyssum maritimum, L. Beach at Kororareka, Bay of Islands; Gisborne, plentiful in January, 1880. (S. Europe.)

Cochlearia armoracia, L. Maintains itself in deserted gardens, but can hardly be considered truly naturalized. (Europe.)

Sisymbrium officinale, L. Waste places, roadsides, etc., pretty generally distributed. (Europe.)

,, *pannonicum*, Jacq. I take this from Mr. Kirk's list. (Trans. ii., p. 135.) I have never seen it. (Europe.)

* *Camelina sativa*, L. Local. Remuera and one or two other places in the vicinity of Auckland. (Europe.)

Brassica oleracea, L. Plentiful in littoral situations, particularly in the northern portions of the district. (Europe.)

,, *campestris*, L. This, with its sub-species *B. rapa* and *B. napus*, is plentiful everywhere in cultivated ground. (Europe.)

,, *nigra*, Boiss. (*Sinapis*, L.) Waste places near Auckland, scarce. (Europe.)

,, *sinapistrum*, Boiss. (*Sinapis arvensis*, L.) A weed in cultivated fields, tolerably frequent. (Europe.)

* ,, *alba*, Boiss. (*Sinapis*, L.) Remuera; cornfields near Otahuhu. (Europe.)

Capsella bursa-pastoris, DC. Frequent through the settled portions of the district. (Europe.)

Senebiera coronopus, Poir. Waste places, not common. Bay of Islands; Thames; Onehunga. (Europe.)

,, *didyma*, Pers. Throughout the district, most abundant, especially in waste places near the sea. (Temperate South America?)

Lepidium ruderale, L. Open situations near the sea, and in waste places throughout the Waikato district. (Europe.)

* ,, *smithii*, Hook. Pastures near Alexandra. (Europe.)

,, *sativum*, L. A garden escape. Hardly naturalized, though common in a cultivated condition. (Europe.)

* *Rapistrum rugosum*, Berg. In the summer of 1876 this plant appeared in great abundance on the Barrack Hill, Auckland, now known as the Albert Park. The grading and laying out of the park during the past year has nearly destroyed it, but a few specimens still linger in the adjoining streets and unoccupied allotments. (Europe.)

Raphanus sativus, L. This has thoroughly established itself in littoral situations, on sand-hills, etc. Mongonui; Bay of Islands; near Auckland; Thames; Raglan, etc. (Europe.)

RESEDACEÆ.

* *Reseda luteola*, L. A garden weed in a few localities near Auckland. (Europe.)

VIOLARIEÆ.

* *Viola tricolor*, L., var. *arvensis*. Near Auckland, scarce. (Europe.)

POLYGALEÆ.

Polygala myrtifolia, L. A garden escape, but well established at Northcote and several other places in the vicinity of Auckland. (Cape of Good Hope.)

CARYOPHYLLEÆ.

* *Dianthus armeria*, L. Fields near Alexandra and other places in the Waikato. (Europe.)

Saponaria vaccaria, L. A garden escape near Auckland. (Europe.)

Silene inflata, Sm. Near Otahuhu; Hamilton; Matamata. (Europe.)

,, *anglica*, L. A common weed throughout the district. The variety *quinquevulnera* is the most abundant. (Europe.)

* ,, *noctiflora*, L. Fields at Matamata, February, 1880. (Europe.)

Lychnis flos-cuculi, L. Pastures at Whangarei, scarce. (Europe.)

,, *githago*, Linn. A weed in cornfields, often seen. (Europe.)

Cerastium glomeratum, Thuill. A common weed throughout the district. (Europe.)

,, *triviale*, Link. Abundant with the preceding. (Europe.)

Stellaria media, L. Universally distributed throughout the district, especially in rich light soils. (Europe.)

* ,, *graminea*, L. Panmure; and the larva fields around Mt. Wellington. (Europe.)

Arenaria serpyllifolia, L. Devonport; Penrose; Panmure; and other places in the vicinity of Auckland. (Europe.)

Sagina apetala, L. North Head, Waitemata, where it has regularly appeared every spring, for several years, on rocks just above high-water mark. Penrose; Onehunga; Newmarket; etc. (Europe.)

Spergula arvensis, L. A common weed in cultivated fields. (Europe.)

Polycarpon tetraphyllum, L. A common roadside weed, also copiously naturalized on sand-hills in the north. (Europe.)

PORTULACACEÆ.

Portulaca oleracea, L. A troublesome weed in gardens in light soil. (S. Europe and Tropics.)

* *Calandrinia caulescens*, H.B.K. I am indebted to Mr. Luke for specimens of this from the vicinity of Otahuhu, where in 1881 it appeared in abundance in a freshly-sown grass field. (Peru.)

* ,, *sp.* A small white-flowered species of this genus, which I have been unable to identify, has become plentiful in stony places by the South Road near Penrose, and thence to Onehunga. (S. America ?)

HYPERICINEÆ.

Hypericum androsæmum, L. A garden escape. Papakura; near Alexandra. (Europe.)

,, *perforatum*, L. Near Auckland; Helensville; common in many localities in the Waikato and Upper Thames districts, especially at Matamata. (Europe.)

,, *humifusum*, L. Whangarei; Remuera; St. John's College; Waitakerei; and other localities near Auckland. Usually prefers stiff clay soils. (Europe.)

MALVACEÆ.

Malva sylvestris, L. Waste places near Auckland; and at the Thames; rare. (Europe.)

,, *rotundifolia*, L. Vicinity of Auckland; Otahuhu; Ngaruawahia; Hamilton; etc. (Europe.)

* ,, *verticillata*, L. In immense abundance in and near Auckland, often covering unoccupied allotments, waste places, etc., with a dense growth 3–4 feet high. Also plentiful at the Thames, Coromandel, and in most of the country townships. (Europe.)

* ,, *parviflora*, L. Waste places near Auckland, but not common. (Europe.)

Modiola multifida, Mœnch. Plentiful in pastures and by roadsides in all cultivated districts. It must have been an early introduction, for it was nearly as abundant and as widely distributed in 1863 as now. (Eastern states of North America.)

Lavatera arborea, L. An occasional garden escape. Panmure; Onehunga; Manukau Heads; Hamilton. (S. Europe.)

Lineæ.

Linum usitatissimum, L. An escape from cultivation in a few localities. (Europe.)

,, *marginale*, A. Cunn. Abundant throughout the district, especially in meadows and by roadsides. Considered to be indigenous by Mr. Kirk. (Australia.)

* ,, *gallicum*, L. Near Lake Pupuke; vicinity of Auckland; Onehunga. Not common; first seen in 1876. (S. Europe.)

Geraniaceæ.

Pelargonium quercifolium, Ait. An occasional garden escape. (Cape.)

* *Geranium robertianum*, L. A few plants of this were seen at Devonport three years ago, but it has apparently died out. (Europe.)

Erodium cicutarium, L. A common plant by roadsides and in waste places. (Europe.)

,, *moschatum*, L. An abundant weed, especially in light soils. (Europe.)

,, *maritimum*, L. In littoral situations. Mongonui; Bay of Islands; Waiwera. (Europe.)

* *Oxalis variabilis*, Lindl. Frequently establishes itself in the vicinity of gardens. (Cape.)

* ,, *cernua*, Thunb. This species has become a troublesome weed in gardens near Auckland, particularly in the large nursery establishments of Messrs. J. Mason and D. Hay. Its numerous tubers make it difficult to eradicate. (Cape.)

* ,, *compressa*, Thunb. Occasionally seen with the preceding, but not common. (Cape.)

* *Tropæolum majus*, L. A common garden escape, especially near Auckland. (Peru.)

Ampelideæ.

Vitis vinifera, L. Often lingers for many years in deserted gardens, old Maori cultivations, etc. (Tropics.)

Sapindaceæ.

* *Melianthus major*, L. A garden escape. Near Mt. Eden; Tararu (Thames); etc. (Cape.)

Leguminosæ.

Podalyria sericea, Br. A common garden plant. It is included in Mr. Kirk's list, but I have never seen it except in actual cultivation. (Cape.)

Ulex europæus, L. Plentiful throughout the whole district, and in many localities exceedingly troublesome. (Europe.)

Cytisus scoparius, Link. Near Papakura; Alexandra; Matamata; etc. (Europe.)

Medicago sativa, L. Cultivated fields, not common. (Europe.)

,, *lupulina*, L. Waste places and fields, tolerably frequent throughout the district. (Europe.)

,, *denticulata*, Willd. Waste places and pastures, common throughout the district. This species and the following often monopolize many of the fields near Auckland, especially where the soil is light and rich. (Europe.)

,, *maculata*, Sibth. Generally distributed. (Europe.)

Melilotus officinalis, L. Fields and waste places, not so common as the following. (Europe.)

,, *arvensis*, Wall. Plentiful, especially in waste grounds near the sea. (Europe.)

* *Trifolium arvense*, L. A few plants noticed in a field near Otahuhu in December, 1876. Not since observed. (Europe.)

* ,, *incarnatum*, L. Occasionally seen in pastures, especially in the Waikato. (Europe.)

,, *pratense*, L. Pastures and roadsides, common. (Europe.)

,, *medium*, L. Pastures, etc., not so common as the preceding. (Europe.)

* ,, *scabrum*, L. Beach at Devonport; abundant in December, 1880. (Europe.)

,, *glomeratum*, L. Fields and roadsides throughout the district. (Europe.)

* ,, *hybridum*, L. Clover fields in the Waikato, and in other localities. (Europe.)

,, *repens*, L. Fields and roadsides, universally distributed throughout the district. (Europe.)

* ,, *resupinatum*, L. Mongonui Harbour and shores of Doubtless Bay, abundant. I am also indebted to Mr. Esam for specimens obtained near Helensville. (Europe.)

,, *procumbens*, L. Not uncommon in meadows in all the cultivated districts. (Europe.)

,, *minus*, Sm. Abundant throughout the district. This mixes more freely with the indigenous vegetation than any other species of *Trifolium*, spreading along the sides of gullies, etc. (Europe.)

Lotus corniculatus, L. Pastures and roadsides, rather local at present, but increasing. (Europe.)

,, *major*, Scop. Remuera; near the Hunua railway station. (Europe.)

* ,, *angustissimus*, L. Remuera: first seen in 1881. (Europe.)

Psoralea pinnata, L. Included in Mr. Kirk's list. I have only seen it in cultivation in gardens. (Cape.)

Indigofera viscosa, Lam. An occasional garden escape near Auckland. (Tropics.)

Robinia pseud-acacia, L. Copiously naturalized in many places in the Waikato country, forming large groves. Near Taupiri it has established itself in places for several miles on the western side of the river. (United States.)

Vicia sativa, L. Not uncommon in cultivated districts throughout the district. (Europe.)

,, *tetrasperma*, Mœnch. A common and troublesome weed throughout the district, from the North Cape to Poverty Bay. (Europe.)

,, *hirsuta*, Koch. Bay of Islands; vicinity of Auckland, and southwards to the Waikato, but by no means common. (Europe.)

* *Lens esculenta*, Gr. & Godr. This has become abundantly naturalized in the Auckland Domain, having doubtless escaped from some garden in the vicinity. (S. Europe.)

Lathyrus odoratus, L. Occasionally establishes itself near gardens, but is not likely to become permanently naturalized. (S. Europe.)

* ,, *latifolius*, L. An occasional garden escape. (S. Europe.)

Dolichos lignosus, L. Spreads in neglected gardens, etc., but can hardly be looked at in the light of a naturalized plant. (Tropical Asia.)

Acacia dealbata, Link. This increases by means of suckers in neglected plantations, etc., and in some localities is fairly established. (Australia.)

Albizzia lophantha, Willd. This was formerly largely planted about the mission stations and Maori settlements, and as it springs up readily from seed, has in many cases formed large groves. (Australia.)

ROSACEÆ.

Amygdalus persica, L. Deserted Maori plantations, etc., and often appearing spontaneously in a variety of situations. (Central Asia.)

Prunus cerasus, L. Maintains itself in deserted Maori plantations and orchards, in a few cases forming small groves. (S. Europe.)

Spiræa salicifolia, Willd. Included in Mr. Kirk's list. I have only seen it where actually planted. (Europe.)

Rubus idæus, L. An escape from cultivation, but well established in a few localities. Lake Pupuke; Hunua; near Drury, etc. (Europe.)

,, *fruticosus*, L. Waste places, hedges, roadsides, etc. Now common in most districts, and rapidly increasing. Several of the subspecies are introduced, *R. discolor*, W. and N., being perhaps the most frequent. (Europe.)

Fragaria vesca, L. }
,, *elatior*, Ehr. } Both species are frequently seen as escapes from cultivation. (Europe.)

* *Potentilla reptans*, L. Near Hamilton, Waikato; a few plants only observed in 1879. (Europe.)

Alchemilla arvensis, L. In cultivated fields and dry pastures. Vicinity of Auckland; Coromandel; Ngaruawahia, Raglan. (Europe.)

* *Poterium sanguisorba*, L. Dry pastures near Auckland, and in the Waikato. Not common, and perhaps intentionally sown in the localities in which I have noticed it. (Europe).

Rosa rubiginosa, L. Abundantly naturalized throughout the district, especially in the light pumiceous soils of the Upper Waikato and Taupo districts. (Europe.)

,, *canina*, L. Hedges and waste places in the vicinity of Auckland, etc. (Europe.)

Rosa multiflora, L. Often planted for hedges, and in favourable situations spreads considerably. (China.)

,, *indica*, L. A garden escape. (China.)

CRASSULACEÆ.

* *Tillæa* (*Bulliarda*) *trichotoma*, E. and L. (?). Sides of the South Road, near Penrose, and spreading rapidly on the lava fields around Mount Smart. I am doubtful as to the identification, the descriptions in the "Flora Capensis" and in De Candolle's "Prodromus," the only ones to which I have access, being very short and meagre. (Cape.)

LYTHRARIEÆ.

Lythrum hyssopifolium, L. An abundant plant throughout the district, in moist places, ditches, etc. (Europe.)

,, *graefferi*, Ten. Local. Remuera; abundant near Ngaruawahia; Thames. (Europe.)

ONAGRARIEÆ.

* *Œnothera biennis*, L. Not common. Near Auckland; waste places about Hamilton; abandoned Maori cultivations at Matamata. (N. America.)

,, *stricta*, L. Common in light soils throughout most parts of the district. Very partial to sandy flats near the sea. (N. America.)

* ,, *tetraptera*, Cav. A garden escape in one or two localities near Auckland. First seen in 1878. (West. N. America.)

CUCURBITACEÆ.

Citrullus vulgaris, Schrad. Often of spontaneous origin about Maori cultivations, but never permanently establishes itself. (Tropics.)

Lagenaria vulgaris, L. This is the "hue" of the Maoris, doubtless introduced by them, and still cultivated in many of their settlements. As a naturalized plant it is in precisely the same position as the preceding species. (Tropics.)

FICOIDEÆ.

* *Mesembryanthemum edule*, L. Naturalized on the sandy beach at Kohimarama, Auckland Harbour; doubtless originally an outcast from some garden in the vicinity. (Cape.)

UMBELLIFERÆ.

* *Bupleurum rotundifolium*, L. Vicinity of Auckland, where it has appeared as a weed in a few large market-gardens. (Europe.)

* *Conium maculatum*, L. A few plants of this were observed in some waste ground at the Thames in 1880; but in a late visit to the locality I did not observe it. (Europe.)

Apium graveolens, L. Deserted gardens and waste places. Brackish-water swamps between the Thames and Piako rivers, a situation where it will probably spread. (Europe.)

,, *eeptophyllum*, A.DC. Mongonui township; Russell (Bay of Islands); Kawau Island (T. Kirk); streets of Auckland; near Otahuhu, etc. Considered by Mr. Kirk to be indigenous, an opinion with which I cannot agree. (Australia.)

* *Ammi majus*, L. Rare at present, but likely to spread. Remuera; Auckland Domain. (Europe.)

Larum petroselinum, Benth. (*Petroselinum sativum*, Hoffm.) An escape from cultivation, but plentiful in several localities, as on the lava-fields round Mount Eden, etc. (Europe.)

Pimpinella saxifraga, L. I take this from Mr. Kirk's list. I have not myself seen it in a naturalized condition. (Europe.)

Scandix pecten-veneris, L. Waste places about Auckland, not at all common. (Europe.)

Fœniculum vulgare, Gærtn. Roadsides and waste places, deserted gardens, etc. Of common occurrence. (Europe.)

Peucedanum sativum, Benth. (*Pastinaca*, L.) A garden escape in a few localities. (Europe.)

Daucus carota, L. Not uncommon in pastures and meadows throughout the district. (Europe.)

Caucalis nodosa, Scop. Waste places, local, Whangarei; vicinity of Auckland; Thames. (Europe.)

ARALIACEÆ.

* *Hedera helix*, L. Spreads occasionally in plantations and gardens, but can hardly be considered as naturalized. (Europe.)

Caprifoliaceæ.

Sambucus nigra, L. Often planted for hedges, etc., and sometimes spreads. (Europe.)

Rubiaceæ.

Galium aparine, L. Waste places, hedges, roadsides, etc., plentiful in most localities, and increasing. (Europe.)

* *Galium parisiense*, L. Fields at Remuera, rare. (Europe.)

Sherardia arvensis, L. Generally distributed through the cultivated districts. (Europe.)

Valerianeæ.

* *Centranthus ruber*, DC. Occasionally seen as a garden escape. Mongonui; Thames; Ponsonby. (Europe.)

Valerianella olitoria, Mœnch. Waste places and roadsides. Orakei native settlement; Mount Albert; near Hamilton. (Europe.)

Dipsaceæ.

* *Dipsacus sylvestris*, L. Tauranga; not uncommon in January, 1880. I am also indebted to Mr. Will for specimens gathered at Pakari. (Europe.)

Scabiosa atropurpurea, L. A common garden escape in light soils. (Tropical Asia.)

* ,, (*Knautia*) *arvensis*, L. A few years ago this appeared in abundance in a cultivated field at Remuera, but has since nearly died out. (Europe.)

Compositæ.

Bellis perennis, L. Plentiful in pastures throughout the district, and increasing yearly. (Europe.)

Erigeron canadensis, L. A common plant through the entire district. Probably one of the earliest introductions into New Zealand. (N. America.)

,, *linifolius*, Willd. (*Conyza ambigua*, DC.) In several localities. Northern Wairoa; Whangarei; Matamata, etc. (Tropics.)

Xanthium spinosum, L. Waste places and roadsides in the vicinity of Auckland; and in the Waikato. It nowhere shows signs of becoming so abundant and troublesome as in certain parts of Australia. (Chili.)

Siegesbeckia orientalis, L. Warm dry soils, not common. Bay of Islands; Whangarei; Northern Wairoa; vicinity of Auckland; Raglan. This must have been an early introduction, for it was more plentiful in 1864 than at present. (Tropics.)

Eclipta alba, Huask. Included in the list of naturalized plants given in the "Handbook" (under the name of *E. erecta*). I have not seen it. (Tropics.)

Wedelia biflora, DC. The same remarks apply. (Tropics.)

Bidens pilosa, L. On cliffs and light dry soils, not uncommon. Perhaps a true native. (Tropics.)

Achillea millefolium, L. In pastures and by roadsides in most cultivated districts, but nowhere very abundant. (Europe.)

Anthemis arvensis, L. Waste places, roadsides, and fields; a common weed in most localities. (Europe.)

* ,, *cotula*, L. Waste places near Auckland. (Europe.)

,, *nobilis*, L. Included in Mr. Kirk's list. I have not seen it except in a cultivated condition. (Europe.)

Chrysanthemum leucanthemum, L. Plentiful throughout the district, and becoming a troublesome weed on stiff soils. (Europe.)

,, *segetum*, L. Local. Cultivated fields at Remuera, and near Otahuhu. (Europe.)

,, (*Pyrethrum*) *inodorum*, L. Fields on the Auckland Isthmus and elsewhere, not common. (Europe.)

Matricaria chamomilla, L. Fields and roadsides, sparsely scattered over the cultivated portions of the district. (Europe.)

,, *discoidea*, DC. In immense abundance in waste places about Auckland, and along most lines of road into the interior. (North America.)

* *Tanacetum vulgare*, L. A few plants observed in a lane near Howick. (Europe.)

* *Soliva anthemifolia*, R. Br. Alluvial flats by the Northern Wairoa River, near Dargaville and Mangawhare. (Australia.)

* ,, *pterosperma*, Less. ? Rangiriri and near Ngaruawahia; first seen in January, 1879. I am not quite certain about the identification. (S. America.)

Artemisia absinthium, L. An occasional garden escape. Northern Wairoa; vicinity of Auckland; Maori settlements at Matamata. (Europe.)

Senecio vulgaris, L. A common weed in rich soils throughout the district. (Europe.)

* ,, *sylvaticus*, L. Near Pukekohe; Raglan. (Europe.)

,, *mikanoides*, Otto. (Harv. et Sond., Flora Capensis, 3, p. 402). *Senecio scandens*, DC., non *Cacalia scandens*, Thunb. A common garden escape, now well established in waste places, etc., near Auckland and elsewhere. (Cape.)

* *Calendula officinalis*, L. A garden escape near Auckland, etc. (Europe.)

Osteospermum moniliferum, L. Recorded by Mr. Kirk. I have not seen it in a naturalized state. (Cape.)

Cryptostemma calendulacea, Br. Light dry soils from Auckland to Waikato; plentiful, but not so abundant as it was four or five years ago. (Cape.)

* *Carduus pycnocephalus*, Jacq. Near Ellerslie; plentiful in one field and by the adjoining road. (Europe.)

Cincus lanceolatus, L. Throughout the district, often an exceedingly troublesome weed in newly-cultivated rich soils, bush clearings, etc., but seldom long occupying any one locality. (Europe.)

Silybum marianum, Gærtn. Bay of Islands, most abundant. Vicinity of Auckland, but rather scarce. Abundant in the vicinity of Tauranga. (Europe.)

Centaurea nigra, L. Fields and roadsides, occasionally seen. (Europe.)

,, *calcitrapa*, L. Waste places about Auckland, rare. (Europe.)

,, *solstitialis*, L. Waste places, roadsides, and sandy shores; spreading fast, especially in the Waikato. (Europe.)

Cichorium intybus, L. Fields in all the cultivated districts. (Europe.)

* *Tolpis umbellata*, L. In abundance between Penrose and Panmure, but not observed elsewhere. First seen in 1868. (S. Europe.)

Lapsana communis, L. A common weed in pastures in all the cultivated districts. (Europe.)

Picris echioides, L. (*Helminthia*, Gærtn.) Fields and waste places, not uncommon. (Europe.)

Crepis virens, L. Waste and cultivated grounds, pretty generally distributed. (Europe.)

,, *fœtida*, L. Fields on the Auckland Isthmus. (Europe.)

,, *taraxicifolia*, Thuill. Remuera; Whau; near Cambridge. (Europe.)

* ,, *setosa*, Haller. Remuera; abundant in one field for several years past. (Europe.)

Hypochæris radicata, L. Universally distributed throughout the district; and perhaps quite as abundant as any naturalized plant. (Europe.)

,, *glabra*. Not nearly so plentiful as the preceeding. (Europe.)

Leontodon (*Thrincia*) *hirtus*, L. Vicinity of Auckland, but not plentiful. (Europe.)

* ,, (*Apargia*) *hispidus*, L. Pastures at Remuera, and at Epsom; rare. (Europe.)

,, (*Apargia*) *autumnalis*, L. Panmure; Otahuhu; near Alexandra. (Europe.)

Taraxacum officinale, Wigg. Truly native; but naturalized forms are the only ones that I have seen in the Auckland district. (Europe.)

Sonchus arvensis, L. Cultivated fields, etc. (Europe.)

,, *oleraceus*, L. Everywhere in cultivated soils. This is doubtless in some of its forms indigenous, but others have been introduced. (Europe.)

Tragopogon porrifolius, L. In several localities on the Auckland Isthmus, but not plentiful. (Europe.)

,, *pratensis*, L., var. *minor*. Included in Mr. Kirk's list. I have not seen it. (Europe.)

EPACRIDEÆ.

Epacris microphylla, Br. Karaka Flats, between Waiuku and Drury, A. T. Urquhart. See Trans. N.Z. Inst., xiv., p. 364. (Australia.)

PRIMULACEÆ.

Anagallis arvensis, L. A common weed throughout the district. (Europe.)

APOCYNACEÆ.

Vinca major, L. A garden escape, but now plentifully established in waste places, fields, etc., and increasing. (S. Europe.)

ASCLEPIADEÆ.

Asclepias nivea, L. An escape from gardens near Auckland. (Tropical N. America.)

GENTIANEÆ.

Erythræa centaurium, L. Generally distributed in all soils and situations, and often mixing freely with the indigenous vegetation. (Europe.)

POLEMOINACEÆ.

* *Collomia coccinea*, Lehm. Has been seen as a garden escape in one or two localities near Auckland. (Chili.)

Gilia (*Navarretia*) *squarrosa*, Hk. and Arn. Not uncommon in the Waikato country. (California.)

BORAGINACEÆ.

* *Borago officinalis*, L. Waste places on the Auckland Isthmus, rare. (Europe.)

* *Myosotis palustris*, With., var *strigulosa*. Vicinity of Auckland; Motuihi Island. (Europe.)

* ,, *arvensis*, Hoffm. Observed in one locality at Whangarei. (Europe.)

Lithospermum arvensis, L. Fields and waste places near Auckland; Panmure; Ohaupo; Alexandra. (Europe.)

Echium vulgare, L. Matamata, abundant. Near Hamilton. (Europe.)

* ,, *plantagineum*, L. Has recently appeared in one or two localities near Auckland. (Europe.)

CONVOLVULACEÆ.

Ipomœa batatas, L. Deserted Maori plantations, etc., often lingering for many years. (Tropics.)

Cuscuta epithymum, Murr., var. *trifolii*. Not uncommon in clover fields in the Waikato district, where it first appeared. (S. Europe.)

SOLANACEÆ.

Lycopersicum esculentum, Mill. A garden escape of short duration. (Tropical America.)

Solanum tuberosum, L. Often lingers for a time in fields where it has been cultivated. (S. America.)

* ,, *marginatum*, L.f. A garden outcast near Auckland. A large clump existed for many years in Alten Road, but is now nearly destroyed. (Tropical Asia and Africa.)

,, *sodomæum*, L. Common on the volcanic hills of the Auckland Isthmus, etc., and also noticed at Mongonui, Bay of Islands, and in the Waikato. (S. Europe and N. Africa.)

* ,, *auriculatum*, Ait. Noticed in one or two places about Auckland; and I have received specimens from Mahurangi collected by Mr. Moat. (Tropical S. America.)

Physalis peruviana, L. Warm sheltered localities through the district, but not so common now as fifteen or twenty years back. (Tropical S. America.)

,, *alkekengi*, L. Included in Mr. Kirk's list. I have not seen it in a naturalized condition. (S. Europe.)

Capsicum annuum, L. A fugitive garden escape. (Tropics.)

* *Nicandra physaloides*, Gærtn. Waste places about Auckland. Scarce at present. (S. America.)

Lycium chinense, Mill. Waste places, hedges, roadsides, etc., pretty frequent about Auckland, and in most of the country townships. (Tropical Asia.)

Datura stramonium. Waste places, yards, etc., near Auckland, but not common. (Tropical Asia ?)

Nicotiana tabaccum, L. An occasional escape from cultivation. (Tropical America.)

SCROPHULARINEÆ.

Verbascum thapsus, L. Volcanic hills, etc., near Auckland; Matamata, plentiful in 1879. (Europe.)

,, *blattaria*, L. Waste places and pastures, Auckland to Waikato. (Europe.)

* ,, *sp.* Fields near Henderson, not observed elsewhere.

Linaria elatine, Mill. Waste places and roadsides. Vicinity of Auckland; Otahuhu; Ngaruawahia; etc. (Europe.)

Digitalis purpurea, L. Auckland Isthmus; Thames; Whangarei. By no means common. (Europe.)

Veronica agrestis, L. A weed of frequent occurrence in most districts. (Europe.)

,, *buxbaumii*, Ten. Plentiful in most cultivated districts. (Europe.)

Veronica arvensis, L. A common weed throughout the greater portion of the district. (Europe.)

,, *serpyllifolia*, L. Fields and moist places, very plentiful. (Europe.)

* *Bartsia viscosa*, L. Near Helensville; Remuera; in great abundance between Pukekohe and Tuakau. (Europe.)

OROBANCHACEÆ.

Orobanche minor, L. Whangarei; in several localities on the Auckland Isthmus, especially on the volcanic cones of Mount Eden and Rangitoto; Drury; near Cambridge. (Europe.)

VERBENACEÆ.

Verbena officinalis, L. In immense abundance about Mongonui; also plentiful in some parts of the Waikato country. In other districts by no means common. (Europe.)

,, *bonariensis*, L. Waste places about Auckland, rare. (S. America.)

LABIATÆ.

Mentha viridis, L. Ditches and waste places in most districts. (Europe.)

,, *piperita*, Huds.
,, *aquatica*, L.
* ,, *sativa*, L.
* ,, *arvensis*, L.
} All introduced, and spreading, especially *M. sativa*. (Europe.)

* ,, *pulegium*, L. Whangarei; in several places about Auckland. (Europe.)

* ,, *australis*, Br. Roadsides between Raglan and Ruapuke; plentiful in January, 1877. (Australia.)

Nepeta cataria, L. Local. Vicinity of Auckland; near Alexandra. (Europe.)

Brunella vulgaris, L. Generally diffused through the entire district, in all soils and situations. One of the most abundant and wide-spreading of our naturalized plants. (Europe.)

* *Cedronella triphylla*, Mœnch. This has become very abundant on the lava streams around Mt. Eden, forming dense clumps many feet in diameter and 3–4 feet high. Doubtless it has escaped from some garden in the vicinity. (Madeira.)

Calamintha acinus, Clairv. Mentioned by Mr. Kirk. It does not appear to have been noticed of late years. (Europe.)

Marrubium vulgare, L. Waste places, roadsides, etc., Auckland to Waikato, not uncommon. (Europe.)

* *Salvia verbenaca*, L. Appeared by a roadside in the suburbs of Auckland some years ago, but seems to have become extinct. (Europe.)

Stachys arvensis, L. A troublesome weed in cultivated ground throughout the district. (Europe.)

* *Galeopsis tetrahit*, L. Waste places near Otahuhu, January, 1881. (Europe.)

PLANTAGINEÆ.

Plantago major, L. Waste places and roadsides through the district. (Europe.)

" *media*, L. Vicinity of Auckland and a few other localities, not common. (Europe.)

" *lanceolata*, L. Everywhere in pastures, etc., specially in medium stiff soils. (Europe.)

" *coronopus*, L. Waste places and sandy soil near the sea. Bay of Islands; Waitemata; Onehunga, most abundant; Tauranga; Poverty Bay. (Europe.)

" *virginica*, L. (?) Rangiriri; Ngaruawahia; and other places in the Waikato. (N. America.)

NYCTAGINEÆ.

* *Mirabilis jalappa*, L. A garden escape near Auckland. (S. America.)

AMARANTACEÆ.

Amarantus caudatus, L. Occasionally seen about gardens, but is hardly naturalized. (Tropics.)

" *retroflexus*, L. Streets of Auckland, and waste places and gardens in the suburbs, not common. (Tropics.)

* " *hybridus*, L. Abundant in waste places about Auckland; also at the Thames and in most of the country townships. Becoming a troublesome weed in gardens in rich or highly-manured soils. (Tropics.)

" *blitum*, L. Waste places and streets of Auckland, not nearly so common as the preceding, (Tropics.)

" (*Euxolus*) *lividus*, L. } Recorded by Mr. Kirk. I have not seen

" " *oleraceus*, L. } either of them. (Tropics.)

" " *viridis*, L. Waste places and streets of Auckland. Also recorded by Mr. Kirk from the Thames, and gathered many years ago at the Bay of Islands by Allan Cunningham. (Tropics.)

* " (*Euxolus*) *gracilis*, Desv. (*Euxolus caudatus*, Moq., non *Amarantus caudatus*, L.) Waste places within the City of Auckland, and as a weed in gardens in the suburbs. (Tropics.)

CHENOPODIACEÆ.

Chenopodium album, L. A common weed in rich soils on the Auckland Isthmus, especially about Onehunga. (Europe.)

,, *murale*, L. Waste places, roadsides, etc., plentiful. (Europe.)

* ,, *bonus-henricus*, L. Noticed at Onehunga in 1878, but perhaps only an escape from cultivation. (Europe.)

Salsola kali, L. Shores of the Waitemata and Manukau, not uncommon. Rare at the Thames. (Europe.)

PHYTOLACCACEÆ.

Phytolacca octandra, L. Waste places and roadsides on the Auckland Isthmus, and especially plentiful on the lava streams from Mount Eden. Waitakerei district, becoming plentiful by the sides of the bush tracks. It has also found its way into many other localities in the provincial district. (Tropical America.)

POLYGONEÆ.

* *Polygonum persicaria*, L. Fields near Panmure. (Europe.)

* ,, *convolvulus*, L. Roadsides and waste places about Auckland, not common. (Europe.)

Fagopyrum esculentum, Mœnch. An occasional escape from cultivation. (Europe.)

Rumex obtusifolius. Abundant throughout the district. The docks must have been very early introductions, for Earl mentions that they were great nuisances in Maori plantations at Hokianga in 1834. (Europe.)

* ,, *pulcher*, L. Throughout the district. This species has increased greatly during the last six years, prior to which it was by no means frequent. (Europe.)

,, *crispus*, L. Generally distributed. (Europe.)

,, *sanguineus*, L, var. *viridis*. Generally distributed. (Europe.)

,, *conglomeratus*, Murr. Recorded by Mr. Kirk. I have not met with it. (Europe.)

,, *acetosa*, L. Not uncommon. (Europe.)

,, *acetosella*, L. A most abundant and troublesome weed throughout the district. (Europe.)

* *Emex australis*, Stein. This has appeared twice in waste places near Auckland, but does not seem to increase. (Australia.)

PROTEACEÆ.

* *Hakea acicularis*. Sm. Has established itself over several miles of open manuka country at the foot of the Waitakerei Range, and is increasing fast. Its origin can be easily traced to a planted hedge in the neighbourhood. (Australia.)

EUPHORBIACEÆ.

Euphorbia helioscopia, L. Light rich soils, plentiful in the Bay of Islands and Whangarei districts,—scarcer to the south. (Europe.)

,, *peplus*, L. A common weed in gardens and cultivated fields. (Europe.)

,, *lathyris*, L. Waste places and roadsides, not common. Whangarei; Lake Pupuke; Devonport; Mt. Eden. (Europe.)

* ,, *hypericifolia*, L. Streets of Auckland. I am indebted to Mr. John Kenderdine for drawing my attention to this plant. (Tropics.)

Ricinus communis, L. Warm and dry localities near Auckland, not uncommon. (Tropics.)

URTICACEÆ.

Humulus lupulus, L. Sometimes seen as an escape from cultivation. (Europe.)

Ficus carica, L. This is wonderfully tenacious of life, and not easily killed when once planted. It is thus frequently seen in abandoned gardens, etc., but can hardly be considered naturalized. (N. Asia.)

Urtica urens, L.
,, *dioica*, L. } Both of these species have made their appearance in waste places about Auckland, but they do not seem to spread. (Europe.)

SALICINEÆ.

* *Salix babylonica*, L. The "weeping-willow" was planted many years ago at the Mission Station, at Tangiteroria, on the Northern Wairoa River, and from branches and twigs floated down the river has established itself in profusion on the banks, often fringing them for miles, and in some places impeding the navigation. It is also naturalized on the banks of the Waikato, but not nearly to the same extent. (Central Asia.)

Salix alba, L. Naturalized on the banks of the Northern Wairoa and Waikato. (Europe.)

SCITAMINEÆ.

Canna indica, L. A garden escape of moderately frequent occurrence. (Tropics.)

IRIDACEÆ.

* *Sparaxis tricolor*, Ker. A garden escape near Auckland, not common. (Cape.)

Sisyrinchium bermudianum, L. Fields on the Auckland Isthmus, not common. Near Matamata, Mr. Kirk (on the authority of Mr. Gillies.) (N. America.)

Iris germanica, L. This species, originally a garden escape, has now firmly established itself in most districts. (Europe.)

* *Watsonia angusta*, Ker. (?) An escape from gardens. (Cape.)

Gladiolus sp. A frequent garden escape. (Cape ?)

Antholyza æthiopica, L. Has established itself in several localities near Auckland. (Cape.)

AMARYLLIDEÆ.

Agave americana, L. Old plants throw up a multitude of suckers. (Tropical N. America.)

LILIACEÆ.

Asparagus officinalis, L. Solitary plants are frequently seen, doubtless originating from seeds conveyed by birds from gardens. (Europe.)

Allium vineale, L. Not uncommon, especially in abandoned Maori cultivations, and sandy plats near the sea. (Europe.)

* ,, *ampeloprasum*, L. Shores of Doubtless Bay. (Europe.)

Asphodelus fistulosus, L. Plentiful about Mongonui. (S. Europe.)

* *Aloe latifolia*, Haworth. An escape from gardens near Auckland. (Cape.)

JUNCACEÆ.

* *Juncus tenuis*, Willd. Northern Wairoa ; Paparata Valley ; Rangiriri ; Ngaruawahia ; between Hamilton and Cambridge. I am now inclined to consider this species as an importation. (Europe.)

ARVIDEÆ.

Richardia africana, Kunth. Ditches and waste places, now plentiful about Auckland and in many places of the country townships. (Cape.)

Colocasia antiquorum, Schott. The *taro* of the natives, often lingering in their deserted cultivations for many years. (Tropics.)

Alocasia indica, Schott. Stated in the Handbook to have been introduced and cultivated by the natives. I have not seen it. (Tropics.)

NAIADEÆ.

Aponogeton distachyon, L. In streams at Waimate, Bay of Islands. Originally planted by the early missionaries. (Cape.)

CYPERACEÆ.

Cyperus tenellus, Linn. f. Now spread throughout the greater portion of the district, from Whangarei to the Upper Waikato. In 1862 confined to a limited district in the immediate neighbourhood of Auckland. Considered to be indigenous by Mr. Kirk. (Cape.)

* *Cyperus rotundus*, L. The well-known "nut-grass" has found its way into several gardens in the vicinity of Auckland, and is likely to prove a serious pest, as its numerous tubers make it difficult to eradicate. (Tropics.)

* ,, *sp.* This belongs to the same section of the genus as the preceding. I have only seen it near Mongonui.

* *Carex panicea*, L. Vicinity of Auckland; Mahurangi. (Europe.)

GRAMINEÆ.

Panicum (*Digitaria*) *sanguinale*, L. A common and troublesome weed in light rich soils throughout the district. (Tropics.)

,, (*Digitaria*) *glabrum*, Gaud. Vicinity of Auckland; not common. (Tropics.)

,, (*Echinochloa*) *colonum*, L. Onehunga. (Tropics.)

,, ,, *crus-galli*, L. Waste places about Auckland and elsewhere; not common. (Tropics.)

Setaria glauca, Beauv. A weed in a few gardens at Onehunga; rare. (Tropics.)

,, *macrostachya*, H.B.K. Between Otahuhu and Papakura, not uncommon. (S. Europe.)

,, *viridis*, Beauv. Vicinity of Auckland, rare. (S. Europe.)

Stenotaphrum americanum, Schrank. Has been planted in many localities, and in some is spreading; but, as it seldom ripens perfect seed, its increase is necessarily slow. (North America.)

Alopecurus agrestis, L. Fields and roadsides; in most districts, but nowhere common. (Europe.)

,, *pratensis*, L. Fields, etc., Auckland to Waikato, not common. (Europe.)

* *Polypogon monspeliensis*, Desf. Muddy places on the shores of the Manukau and Waitemata Harbours, increasing fast. (Europe.)

* ,, *fugax*, Nees. Waste places, ditches, etc., on the Auckland Isthmus, increasing fast. Thames, J. Adams. (Tropics.)

Phalaris canariensis, L. Common throughout the district. (S. Europe.)

Anthoxanthum odoratum, L. Spread through the whole district, much too abundant in many pastures. (Europe.)

Phleum pratense, L. Often seen in pastures, but not nearly so abundant as it should be, considering the extent to which it is sown. (Europe.)

Agrostis vulgaris, With. Pastures and roadsides, very generally distributed. (Europe.)

,, *alba*, L. Equally abundant as the preceding, but usually affecting stiffer soils and damper situations. (Europe.)

Gastridium lendigerum, Gaud. Auckland Isthmus; Waitakerei; Otahuhu. (Europe.)

* *Ammophila arundinacea*, Host. Has been planted in one or two places on the western coast to check the progress of sand-dunes, and may be expected to increase, as it has done at Taranaki and Nelson. (Europe.)

* *Lagurus ovatus*, L. Motuihi Island, extremely plentiful; near Auckland, rare. (Europe.)

Aira caryophyllea, L. Common in most localities. (Europe.)

* ,, *præcox*, L. A few plants observed near Waiuku in December, 1877. (Europe.)

* *Deschampsia flexuosa*, L. Fields on the Auckland Isthmus, rare. (Europe.)

Holcus lanatus, L. Abundant, one of the most wide-spread of the naturalized grasses. (Europe.)

,, *mollis*, L. Abundant. (Europe.)

* *Trisetum flavescens*. Local and rare at present. Thames; Hamilton. (Europe.)

Avena sativa, L. Has become extensively naturalized on sea-cliffs in the northern and central portions of the district, in addition to frequently occurring in fields as an escape from cultivation. (Europe.)

Arrhenatherum avenaceum, Beauv. Established in a few situations about Auckland. (Europe.)

Cynodon dactylon, L. Plentiful throughout the district. (S. Europe, etc.)

* *Triodia decumbens*, L. I am indebted to Mr. H. Hunter for specimens gathered on the Kumeu Flats, Kaipara. (Europe.)

Cynosurus cristatus, L. Not uncommon on stiff soils in various portions of the district. (Europe.)

Eragrostis brownii, Nees. Bay of Islands; Northern Wairoa; Whangarei; near Auckland. (Australia.)

Dactylis glomerata, L. Generally distributed. (Europe.)

Briza minor, L. Generally distributed. (Europe.)

,, *maxima*, L. Northcote; Ellerslie; near Howick. (S. Europe.)

Poa annua, L. Throughout the district. (Europe.)

,, *pratensis*, L. Throughout the district. (Europe.)

* ,, *compressa*, L. Auckland Isthmus, not common. (Europe.)

,, *trivialis*, L. Waste places about Auckland, and occasionally in pastures. (Europe.)

,, *nemoralis*, L. Auckland Domain. (Europe.)

* *Glyceria fluitans*, L. Made its appearance in some wet places on the Auckland harbour reclamations, about two years ago, but has been lately destroyed. (Europe.)

Festuca pratensis, L. Pastures, not common. (Europe.)

,, *myurus*, L. The true plant by no means abundant, but increasing. The variety *sciuroides* = *F. bromoides*, Sm.—plentiful through the district. (Europe.)

Bromus erectus, Huds. Recorded by Mr. Kirk. I have not observed it. (Europe.)

,, *sterilis*, L. Plentiful, especially in waste or sandy places near the sea. (Europe.)

,, *madritensis*, L. } Included in Mr. Kirk's list. I have not seen
,, *tectorum*, L. } them. (Europe.)

,, *mollis*, L. Generally distributed. (Europe.)

,, *racemosus*, L. Equally abundant with the preceding, together with its variety *B. commutatus*, Schrad. (Europe.)

,, *arvensis*, L. Not common. Waste places near Auckland, etc. (Europe.)

,, *patulus*, Reich. Included by Mr. Kirk in his catalogue. I have never gathered it. (Europe.)

,, *unioloides*, DC. The prevailing grass in many of the streets and waste places about Auckland. Not so common in the country, as it will not bear close cropping. (N. America.)

Lolium perenne, L. Plentiful through the district. (Europe.)

,, *italicum*, A. Braun. Pastures and waste places, not common. (Europe.)

,, *temulentum*, L. Cultivated fields in most districts. (Europe.)

Triticum sativum. An occasional escape from cultivation, but never lasts long in one situation. (Europe.)

Lepturus incurvatus, Trin. Common in brackish-water swamps, etc. (Europe.)

Hordeum vulgare, L. Sometimes lingers in cultivated fields. (Europe.)

,, *murinum*, L. Sandy flats near the sea. Waitemata; Thames; Tauranga. (Europe.)

Arundinaria macrosperma, Michx. Lingers in several old Maori settlements, but cannot be looked upon as truly naturalized. (North America.)

The following species, included in Mr. Kirk's Catalogue of the Naturalized Plants of Auckland, should be altogether struck out of our lists:—

Fumaria parviflora, Lam. Mentioned in the "Flora of New Zealand," vol. 2, p, 321. I believe that I am correct in stating that this has not been seen by any recent botanist.

Gypsophila tubulosa, Boiss. Included by Dr. Hooker in his list of naturalized plants, but is doubtless a true native.

Geranium molle, L. The same remarks apply.

Eutaxia strangeana, Turcz. Stated by its author to come from New Zealand, probably through some mistake. It will doubtless prove to be some well-known Australian plant.

Guilandina bonduc, L. Erroneously stated by Forster to come from New Zealand. See "Handbook," p. 53.

Opuntia vulgaris, Mill. Recorded by Sir J. D. Hooker in the lists of naturalized plants appended to both the "Flora" and the "Handbook;" but must be expunged, as it never spreads out of cultivation in New Zealand.

Anthriscus cerefolium, Hoffm. "Handbook," p. 759. Has not been noticed by any recent botanist.

Arnoseris pusilla, Gærtn. If this is the species meant by the name "*Lapsana pusilla*, L.," quoted in the "Handbook, page, 760, the preceding remarks apply also.

Stylidium graminifolium, Swz. No specimens of this have been found in New Zealand since the solitary one obtained by the late General Bolton in 1851.

Epacris purpurascens, Br. Fl.N.Z., vol 2, p. 321. It appears preferable to regard this as indigenous.

Cynoglossum micranthum, Br. (?). "Handbook," p. 197. No. species of this genus has been obtained in New Zealand of late years.

Solanum nigrum, L. "Handbook," p. 761. Should be considered as indigenous.

,, *virginianum*, L. Kirk, Trans., 2, p. 140. It appears to be quite uncertain what plant Linnæus had in view when he applied this name, which had much better be dropped. I have no idea what species Mr. Kirk had in mind.

Verbascum phœniceum, L. Kirk, Trans., 2, p. 141. Has not been seen in a naturalized state of late years.

Herpestes cuneifolia, Spr. Erroneously included in Raoul's list of New Zealand plants.

Veronica officinalis, L. I am not aware that this has been observed in a naturalized state in the Auckland district.

,, *anagallis*, L. Should probably be looked upon as indigenous.

Phytolacca decandra, L. "Handbook," p. 701. Introduced into the lists by mistake, as explained by Mr. Kirk (Trans. 2, p. 141.)

Polygonum aviculare, L. It is perhaps preferable to regard this species as indigenous.

,, *minus*, L. "Handbook," p. 761. Is certainly indigenous, if the variety *decipiens* is the plant meant; and I am not aware that any other form has been seen in New Zealand.

Chenopodium urbicum, L. I have never seen this in the Auckland district.

,, *ambrosioides*, L. Probably a true native.

Iatropha curcas, L. Fl.N.Z. 2, p. 322. Extremely unlikely to become naturalized in any part of New Zealand.

Dioscorea alata, L. Fl.N.Z., 2, p. 322. May have been cultivated by the Maoris, but I very much doubt its becoming naturalized.

Panicum gibbosum, Br. Erroneusly introduced into Raoul's list.

Aristida calycina, Br. Supposed to have been gathered at the Bay of Islands by Cunningham, no doubt through some mistake.

Eleusine indica, Gærtn. "Handbook," p. 331. Has not been seen of late years.

Anthistiria australis, Br. "Handbook," p. 325. The same remarks apply, so far as the district of Auckland is concerned.

Apluda mutica, L. "Handbook," p. 325. No botanist has observed this since Dr. Sinclair's time.

Andropogon refractus, Br. "Handbook," p. 325. Reported from New Zealand by Allan Cunningham, but it has not since been met with.

Eragrostis eximia, Steud. Stated by its author to come from New Zealand; but his description has not been recognized.

Art. XXXVI.—*On some recent Additions to the Flora of New Zealand.*

By T. F. Cheeseman, F.L.S.

[*Read before the Auckland Institute, 29th May and 31st July, 1882.*]

1. *Cardamine latesiliqua*, n. sp.

Varying in size from four inches to over two feet. Rootstock stout, spongy, as thick as the finger, often branched at the top, and each division furnished with a rosette of densely-crowded radical leaves. Flowering stems few or many, arising from the top of the rootstock, erect or slightly spreading, leafy. Radical leaves 3–6 inches long, $\frac{1}{3}$–$\frac{2}{3}$ inch broad, variable in shape, narrow linear-spathulate to nearly obovate-spathulate, gradually narrowed to the base, coarsely and sharply serrate in the upper portion, very thick and coriaceous, margin and midrib and sometimes the whole surface more or less villous-pubescent. Cauline leaves smaller, lanceolate, nearly entire. Flowers rather large, white, very numerous. Pedicels $\frac{1}{4}$–$\frac{1}{2}$ inch long. Petals nearly $\frac{1}{2}$ inch long, spathulate, on long claws. Pods very numerous, suberect, usually curved, somewhat swollen, $1\frac{1}{2}$–$2\frac{1}{2}$ inches long, $\frac{1}{5}$–$\frac{1}{4}$ inch broad. Seeds numerous, compressed, reddish-brown.

Hab. Nelson Mountains. Mount Arthur, not uncommon between 4,000–5,500 feet; Mt. Owen, abundant on limestone rocks above 3,500 feet; Raglan Mountains, altitude 5,000 feet.

This handsome species has much of the habit and general appearance of *C. fastigiata*, but is at once distinguished by the broad pods, which are more than twice the diameter of those of *C. fastigiata*, and have in addition a peculiar turgid or swollen appearance very unusual in the genus. The pods of *C. fastigiata* (which I have gathered in a fruiting condition at the Wairau Gorge) are flat and narrow, and never more than $\frac{1}{10}$ inch in diameter.

2. *Cotula linearifolia*, n. sp.

Dark green, rather thick and fleshy, very aromatic, sparingly pilose. Stems branched, prostrate, ascending at the tips. Leaves $\frac{1}{2}$–$1\frac{1}{2}$ inches long, $\frac{1}{12}$–$\frac{1}{8}$ inch broad, thick and fleshy, narrow linear or linear-spathulate, quite entire, sprinkled with minute glandular dots, blade gradually narrowed into a broad sheathing petiole. Scapes 2–4 inches long, rather slender, with from 4–8 linear or linear-subulate bracts. Heads unisexual, $\frac{1}{4}$–$\frac{1}{3}$ inch diameter. Scales of the involucre in about three series, linear-oblong, obtuse, herbaceous, with a broad green centre and thin brownish margins; receptacle convex, papillose; florets usually with numerous rounded transparent glands. Female florets—corolla thick and fleshy, swollen at the base, somewhat tetragonous, narrowed above, with 4 short erect lobes; achene linear-obovate, compressed. Males—smaller and more slender, funnel-shaped, 4-lobed.

Hab. Mountains flanking the Wairau Valley, Nelson, alt. 3,000–4,500 feet.

A curious little species, allied to *C. pyrethrifolia*, Hook. f., in the structure of the flower heads and in the numerous linear bracts, but differing from it, and all the other New Zealand species, in the narrow entire leaves. In outward appearance it somewhat resembles *Abrotanella linearis*, Berggren.

3. *Veronica cheesemani*, Benth.

(Hook. f., Icones Plantarum, t. 1366, a.)

Small, greyish green, densely tufted, forming rounded cushions 2–5 inches in diameter, pubescent in all its parts. Branches slender, closely compacted and intertwined. Leaves $\frac{1}{8}$–$\frac{1}{4}$ inch long, narrow obovate, lobulate, or pinnatifid, lobes obtuse, narrowed into a long or short broad petiole. Flowers white, solitary, axillary, very shortly pedicelled, $\frac{1}{8}$ inch diameter. Calyx deeply divided into four spreading linear-spathulate segments, that are coarsely toothed towards the top. Corolla slightly longer than the calyx, four-lobed, lobes obovate, emarginate. Ovary broadly ovoid, hispid. Capsule much shorter than the sepals, broadly didymous, slightly compressed, hispid, ultimately splitting to the base into four oblong obtuse valves.

Hab. Mountains of Nelson. Summit of Gordon's Nob, alt. 4,000 feet. Raglan Mountains, Wairau Valley, alt. 4,000–5,000 feet.

This belongs to the section of the genus with solitary axillary flowers, of which *V. canescens*, Kirk, is the only other species described from New Zealand. Our plant differs in habit, larger size, smaller white flowers, and in the pinnatifid leaves.

4. *Pterostylis mutica*, R. Br.

(R. Br., Prodr. 328; Bentham, Flora Australiensis, vol. vi., p. 362.)

Leaves in a radical rosette at the base of the stem, ¼–½ inch long, ovate, shortly petiolate, reticulate, apparently withering at the time of flowering. Stem 2–5 inches high, with 2–4 empty sheathing bracts below the flowers. Flowers 2–5, arranged in a slightly spiral spike, greenish-brown. Galea broad, much incurved, obtuse or subacute at the tip, hardly three lines long. Lower lip broad, almost orbicular in outline, concave, reflexed, with two short broad lobes. Labellum placed on a short flat claw, short, broad, and obtuse; appendage nearly as broad, entire, rounded. Column erect; wings broad, lower lobe broad and obtuse.

Hab. Lee Stream, near Dunedin; Mr. Sydney Fulton.

I am indebted to Mr. G. M. Thomson, of Dunedin, for specimens in spirit of this curious little species. It was first found in New Zealand by Mr. Fulton some two years back, and was identified in the "New Zealand Journal of Science" with *P. aphylla*, Lindl., a local Tasmanian species. It clearly belongs, however, to the section of the genus having the lower lip reflexed, and agrees so closely with the well-known Australian *P. mutica*, Br., that I cannot doubt its being the same species. New Zealand specimens are much smaller than Australian, but that may be due to the nature of the locality in which they were found. The structure of the flower agrees very well with the details given in Mr. Fitzgerald's plate in his "Australian Orchids," and with dried specimens that I have examined; with the exception of a slight difference in the shape of the appendage to the labellum—always a variable organ in this genus.

5. *Scirpus* (*Isolepis*) *crassiusculus*, Hook. f.

(Benth., Flora Australiensis, vol. vii., p. 326.)

Rhizome apparently elongated, branched, rooting at the nodes. Leaves very narrow linear, almost filiform, 1½–2 inches long. Stems about 3 inches long. Spikelet solitary, terminal, pale brownish-green, ovate, rather more than ⅓ inch long, many-flowered. Glumes ovate, obtuse, striate, herbaceous, with a green centre and purplish-brown margins. Stamens 3. Style-branches 2. Nut greyish-white, very nearly orbicular, but slightly broader above and produced into a short point, much flattened, centre biconvex, then becoming thinner, margin thickened all round.

Hab. Swamps in the Rangipo desert, eastern base of Ruapehu; Mr. H. Tryon.

Of this plant I have only received three small specimens. So far as these go, they correspond exactly with the description and plate in the Flora of Tasmania, and with Bentham's description in the Flora Australiensis; and at present I have no reason whatever to doubt the identification. A full series of specimens will be required, however, before the matter can be absolutely settled. The species is more nearly allied to *S. fluitans* than to any other of our New Zealand forms, but differs in being stouter, apparently not so much branched, and in the very much larger spikelet. Mr. Tryon informs me that it is not uncommon in ferruginous swamps in the Rangipo desert, associated with *Scirpus cartilagineus*, *Pratia angulata*, *Drosera arcturi* and *D. spathulata*, *Gunnera prorepens?*, and *Utricularia monanthos*.

6. *Carex devia*, n. sp.

Culms 9–18 inches high, smooth or nearly so, hardly tufted, leafy at the base only. Leaves shorter than the culms, very coriaceous, rigid, keeled, strongly grooved, $\frac{1}{10}$–$\frac{1}{6}$ inch diameter; margins scabrid. Lower bract long and leafy, rest small. Spikelets 2-4; terminal one the largest, male, or very rarely with a few female flowers at the base, stout, clavate, $\frac{3}{4}$–$1\frac{1}{2}$ inch long; remainder all female, variable in size, $\frac{1}{2}$–$1\frac{1}{4}$ inch long, erect, oblong or cylindric, upper sessile, lower very shortly pedunculate, in small specimens often closely approximate, in larger ones more distant, dark chestnut-brown or rarely blackish-brown. Glumes dark rich brown with a green centre, ovate, acute, emarginate or shortly bifid, the midrib produced into a hispid awn of varying length. Perigynia rather longer than the glumes, dark purplish-black, ovate or elliptic, compressed, unequally biconvex or nearly plano-convex, strongly nerved and wrinkled, margins entire; beak short, broad, terminated by two widely divergent teeth. Stigmas two.

Hab. Mountain districts in Nelson, not uncommon above 2,500 feet altitude.

This appears to be a very distinct species, and when once noticed cannot be confounded with any other. It may be readily identified by its seldom forming tufts, by its rigid and coriaceous grooved leaves, very stout clavate male spikelets, and by the broad conspicuously grooved and wrinkled perigynia.

Art. XXXVII.—*Notes on Fresh-water* Algæ. By W. I. Spencer, M.R.C.S.

[*Read before the Hawke's Bay Philosophical Institute, 9th October*, 1882.]

Plates XXVI. and XXVII.

In continuation of the Catalogue of the Fresh-water Algæ occurring in the vicinity of Napier, which I laid before you last year,* I beg this evening to call your attention to the following additions which have come to my notice since then.

Draparnaldia sp. ?. Fig 1.

Filament branched, $\frac{1}{400}''$ in diameter, tapering towards apex, cells as long as, or twice as long as broad. Branchlets (ramuli) bipinnate $\frac{1}{2266}''$ in diameter, cells slightly longer than broad, terminal ones pointed, tufted, near apex filament gives out a large number of elongated jointed processes, which are mostly simple, but sometimes branched. I am indebted for this plant to Mr. Hamilton, who discovered it in the Horokiwi stream. Possibly a variety of *D. glomerata*.

Cladophora pacifica, Kuch.

Montague (Voy. au Pôle Sud) mentions this as having been found in Lord Auckland's Group.

Cladophora longiarticulata, Kuch.

Found by Nordstedt in the Sandwich Islands.

Staurocarpus.

Spirogyra, sp. n. Fig 2.

Cells square, very rarely twice or four times longer than broad, this probably only when on the point of dividing, ends slightly convex, never retracted. Endochrome arranged in three distinct straight bands at right-angles to wall of cell, and with no visible connection. Each band consisting of three or four minute round cellules, containing chlorophyll. Sporange formed in parent cells, globular.

Cells.—Diameter, $\frac{1}{700}''$; length, $\frac{1}{700}''$, rarely $\frac{1}{350}''$ or $\frac{1}{175}''$.

Zygospore $\frac{1}{1400}''$ in diameter.

This little plant is easily recognized by the rigidity of the filament, the masonic regularity with which the cells are arranged—the convex ends of which just touch—and the singular arrangement of the endochrome.

Common.

Zygnema, sp. n. Fig. 3.

Ends of cells retracted. Contents consist of twin stellate masses of endochrome. Zygospore lodged in the filament, oval, filling but not bulging the cell. Spore bearing cell appears to be somewhat smaller than the others.

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* "Trans. N.Z. Inst.," vol. xiv., art. xliii.

Filament.—Diameter $\frac{1}{500}''$.

Length of cell.—$\frac{1}{350}''$ to $\frac{1}{380}''$.

Zygospore.—Length, $\frac{1}{412}''$; breadth, $\frac{1}{700}''$.

Diameter of sporiferous cell, $\frac{1}{700}''$.

From Ruataniwha.

Zygnema, sp. n. Fig. 4.

Cells retracted at the ends. Eleven or twelve lines longer than broad. Zygospore globular, lodged in the connecting tube, the length of which varies considerably.

Filament.—Diameter, $\frac{1}{1400}''$.

Cells.—Length, $\frac{1}{107}''$ to $\frac{1}{128}''$.

Diameter of zygospore, $\frac{1}{1000}''$.

Length of connecting tube from $\frac{1}{350}''$ to $\frac{1}{466}''$.

Also from Ruataniwha—

Bulbochæte setigera.

Œdogonium princeps.

Vaucheria sessilis.

Rivularia iridis.

Oscillatoria and *Vibrio.*

A series of the last-mentioned plants I found in samples of water from the hot springs at Taupo, growing in water the temperature of which varied from 105° F. to 136°. They all exhibited the motions peculiar to this class of Algæ.

Fig. 5. (*a*) *Oscillatoria* sp., contains a row of cells; diameter of filament, $\frac{1}{5000}''$. (*b*) *Vibrio*, alternate dark and light cells; diam., $\frac{1}{14000}''$; temp., 105°. (*c*) *Oscillatoria*, diam., $\frac{1}{7000}''$; temp., 116°. (*d* and *e*) probably the same although varying much in diameter, which is $\frac{1}{2300}''$ and $\frac{1}{3500}''$; temp., 116° and 130°; (*f*) temp. 136°, diam. $\frac{1}{14000}''$. This plant is so unlike an *Oscillatorian* that had it not been for the movements, which consisted of both side-way motion and also progression and retrogression, I should not have recognized it. (*g*) *Oscillatoria*, diam., $\frac{1}{7000}''$; striæ evident, close; temp., 136°.

I have found about 12 Desmids not hitherto discovered in this country, one of which is probably new. My time, however, has not permitted me to include them in these notes. Mr. Maskell, of Christchurch, has therefore undertaken their description, and they will be found in his paper.*

Fragillaria pectinalis.

Gomphonema acuminatum.

Gonium pectinale.

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* Art. XXXI., supra.

DESCRIPTION OF PLATES XXVI. AND XXVII.

Fig. 1. Draparnaldia.

2. Spirogyra.
    - (a) filaments conjugating.
    - (b) zygospore.
    - (c) the same commencing to grow.
3. Zygnema.
4. Zygnema.
5. Oscillatoriæ from Taupo.

Art. XXXVIII.—*A Description of four new Ferns from our New Zealand Forests.* By William Colenso, F.L.S.

[*Read before the Hawke's Bay Philosophical Institute, 12th June, 1882.*]

I. Cyathea, *Smith.*

Cyathea tricolor, sp. nov.

Plant, arborescent; *trunk* stout, 5–12 feet high, bulky at base and at top, 1 foot diameter there, fibrous at base and for 2–3 feet up, thickly clothed with broken stipites at top; colour, light-brown.

Fronds numerous, 30–40, tri-pinnate, spreading, drooping, glabrous, shining, 7–8 feet long, 38–40 inches broad in widest part, oblong-lanceolate not acuminate, decreasing very gradually downwards, sub-membranaceous, dark-green above, white below.

Stipes very stout, 3–3½ inches girth at base, short, 3–4 inches long, obscurely triquetrous, flattish or a little rounded at top, and slightly channelled towards base, brittle, succulent, gummy, dark-olive green above, peculiar bluish-white below, prickly with small fine sharp black prickles, $\frac{1}{12}$ inch long, recurved, scattered, in some places very closely set, 2 to a line, and sometimes running in irregular rows; *scales*, at base of stipes, very numerous, long, shining, dark-brown, 2 inches long, and 2 lines broad at base, flat, thin, very acuminate, finely striated longitudinally, margins entire, crumpled towards top, concave and transversely corrugated at base.

Rhachis, main and secondary, glabrous, bright golden-yellow above, finely and floccosely tomentose below with deciduous ferruginous tomentum, bluish-white underneath, subcylindrical not channelled below, (but channelled above in *dried* specimens), main rhachis (and stipe) marked longitudinally on both upper outer edges with a line of oblong-lanceolate brick-red scars, and having 2–3 of such red blotches at the base of each pinna, always nearer to the upper angle.

Pinnæ, distant (4–5 inches) on rhachis, alternate sometimes opposite, lowest two pairs opposite, the largest near the middle 18–19 inches long, 8–9 inches broad, drooping.

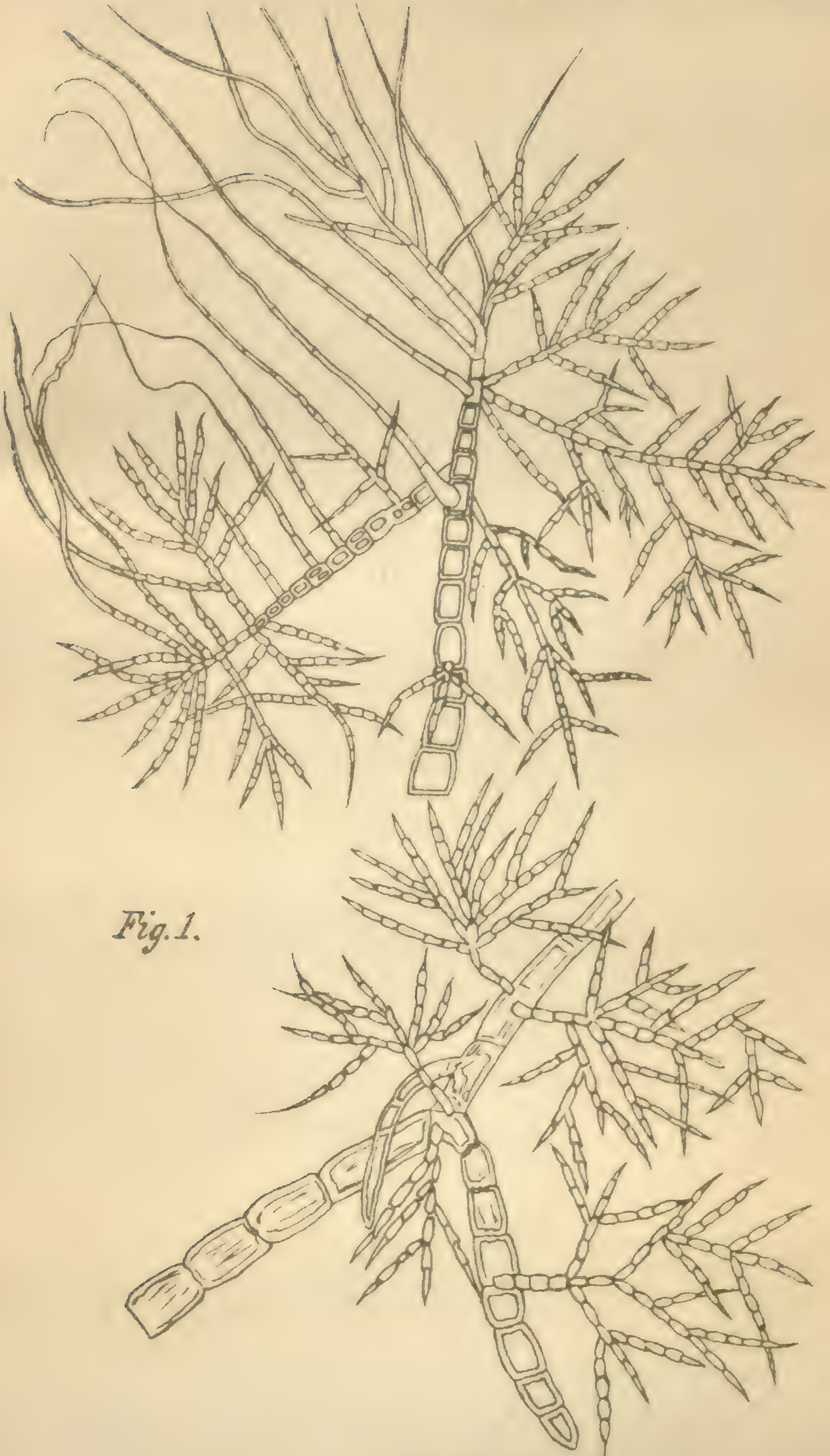

Fig. 1.

FRESH WATER ALGÆ.

Dr. Spencer del.

Pinnules (secondary divisions), sessile, 3½–4½ inches long, 10–12 lines broad, broadest at base, triangular, finely and very beautifully acuminate, apices finely and regularly serrated to tip.

Segments, sessile, 5–6 lines long, 1 line broad, linear, entire, margins conniving in fruit and subcrenulate at sori, pointed, distant, falcate, lower pinnate and pectinate, the single lowest segment on the underside of pinna subpetiolate; veins red, 9–10 jugate on a segment, simple, forked, and branching.

Sori, in axil of fork of veins, nearer midrib than margin, numerous, crowded filling segments, large, regular, biseriate, 14–18 on a large segment, dark-brown, extending to tips of pinnules and pinnæ, with always one close set in at base of segment to rhachis of pinnule.

Involucre, a shallow circular cup, margin entire, rarely breaking-up.

Receptacle, broadly clavate, pubescent; showing point of insertion by a pit on upper side of segment.

In both its young and barren state this species of *Cyathea* might be easily confounded at first sight with the well-known and ubiquitous New Zealand species *C. dealbata*, from its being equally as white on its foliage below. On examination and comparison however, of living specimens, the two whites on the under foliage of the two plants will be found to differ greatly,—that of this one possessing a bluish tint, (just the hue of the oxidized corrugated iron roofing of our houses,) which colour is more particularly shown on its thick and succulent stipes, which are also thickly set with small sharp black prickles. Indeed, in its young and barren state, the whiteness of the underside of the fronds of this species, often shows even more conspicuously than that of *C. dealbata*, when a frond is turned up or half-reversed in its native woods; owing to the much greater contrast arising from the darker-green of its upper foliage.

In its many colours, too, this fern is peculiar:—1. its shining dark-green upper foliage; 2. its large, thick, glossy golden-yellow prominent stalks (rhachises, main and secondary); 3. its white underneath, appearing so solid, unbroken, through its being so glabrous there also, and not having there any large coloured scales or hairs; and 4. (when in fruit) its shining dark-brown clusters of large sori, showing to advantage on their white ground. Indeed, I might truly enough have specifically named it *versicolor*.

Another striking peculiarity of this species when in fruit, is its general and regular drooping appearance, and that, not merely of its large fronds inclining forwards and downwards, as obtains with some other of its congeners (as *C. medullaris* and *C. polyneuron*), but its characteristic threefold, or even fourfold, manner of drooping:—firstly, its fronds outwards and

downwards; secondly, their pinnæ downwards and inwards towards the main rhachis; thirdly the pinnules downwards and inwards towards the secondary rhachises; and then, fourthly, the very fruiting segments themselves conniving inwardly:* the whole *tout-ensemble* being peculiar among our tree-ferns, and most graceful.

Owing to its many colours, its drooping compact shape, and its being much more of a dwarf (though stout) tree-fern than its congeners, fully bearing fruit when only five feet high, it wears a very peculiar and striking appearance (especially when looking down on it from a height a little above)—one that attracts the eye immediately.

I have long known this fern in its young and barren state; and I had always a suspicion that it was really distinct from *C. dealbata;* but Dr. Sir J. Hooker had so clearly stated that *C. dealbata* was our only tree-fern bearing "fronds" that were "white and glaucous below," that I confess I have been for a considerable time thrown off my guard with respect to it. But during this last autumn, while botanizing in another and unvisited part of the Seventy-mile Bush, I fell in with several plants of this species, of various sizes and ages, and many of them bearing fruit in profusion, so I had ample means and opportunity for examination.

Hab. Deep forests (Seventy-mile Bush) on eastern outlying spurs of the Ruahine Mountain Range, between Norsewood and Danneverke villages; April, 1882.

II. **Dicksonia,** *L'Héritier.*

Dicksonia gracilis, n. sp.

Plant, arborescent; *trunk* 10–15 feet high, slender, greyish-brown; on upper portion remains of old stipites, and at top a few dead fronds hanging down; bearing young plants and shoots 2–3 feet from the base.

Fronds, 40 and upwards, sub-membranaceous, glabrous, 5–5½ feet long, 2–4 feet wide, tripinnate, oblong-lanceolate, patent, light-green above and lighter-green below, upper portion very free and loose not compact.

Stipes, 9–10 inches long, at first upright and inclined inwards towards trunk, sub-clasping, with a large quantity of loose light red-brownish hairs at bases, and a dense layer of lighter coloured hirsute tomentum adhering beneath; *hairs,* 1½ inch long, cylindrical, tapering, excessively fine towards top, straight and lax, shining as if varnished, regularly jointed, 6 joints to 1 line, semi-bulbous at base; *stipes* and *rhachises* dark-brown below, shining as if varnished, and thickly muricated throughout to apices of pinnæ with

* This habit, however (so widely different from that of *C. dealbata*), makes it a very difficult matter to lay out and dry a specimen flat; indeed, I have been obliged to abandon it, save in a few small segments, although I took with me into the forest a portfolio having remarkably thick covers.

fine raised black points; *main rhachis* deflexed from stipe, longitudinally sulcated above; *stipes* and *rhachis* densely hairy when young; hairs, patent, red-brown.

Pinnæ, 15 inches long, 4–5 inches broad, about 3 inches apart on rhachis, petiolate, triangular, broadest near base, acuminate ending in a very fine point, densely covered with red-brown strigose hairs above on rhachis of pinnæ.

Pinnules, sub-opposite, distant, 2–2½ inches long, broad, linear-oblong, broadest near base, acute, sub-falcate, petiolate, glabrous above on midrib, hairy below and also on midrib of segments; *barren pinnules* pinnatifid, *fertile* pinnate.

Segments free not crowded, sessile, alternate, oblong, 3 lines long, 1 line broad, obtuse, apices rounded, slightly and sparingly serrate, sub-falcate, lowermost one on upper side of pinnule regularly overlapping secondary rhachis; fruitful segments very distant, regularly crenulate through contraction by sori, auricled, lowest pair petiolate; *costa* prominent above; *veins*, 5-jugate, forked and simple.

Sori numerous, crowded, occupying the whole of the segment, small, globular, biseriate, 8–10 to a segment.

Involucre, outer valve sub-cucullate, margin entire, about ½ line long, remaining green-coloured when dry.

The buds, shoots, and young plants of various ages and sizes, bursting forth from the stem of this fern-tree, was a curious and pleasing sight—and, to me, a novelty. They were scattered around the main stem, 8–12 inches apart, and at different heights, but all within 2–3 feet from the base; from them I gathered fronds of various sizes, the largest 12 inches long,—one, 7 inches, and one, 4 inches long, exclusive of stipe; these are all very soft in foliage, bipinnate only, with stipes and main and secondary rhachises exceedingly hairy with long patent jointed hairs,—quite a miniature of the large fronds of the parent plant. Some of the smaller shoots like big buds, apparently just bursting, possess most delicately fine, long, and soft hairs, almost curly, coloured and jointed like those of parent plant.

This species of *Dicksonia*, in general appearance, somewhat resembles *D. squarrosa*, but wants the black trunk and stipes, the harsh and dry pointed and mucronate coriaceous foliage, and black hairs and bristles of that species, as well as the persistent hanging of its old withered fronds around its trunk, which is almost characteristic,—besides the much smaller fronds and small round sori, and the peculiar habit of bearing shoots and buds on the trunk of this species. It has the slenderest trunk, as well as the most airy and light appearance in its crown of fronds, of all the New Zealand *Dicksoniæ* known to me.

Hab. In low-lying forests between Norsewood and Danneverke, "Seventy-mile Bush," April, 1882.

III. **Hymenophyllum,** *Smith.*

Hymenophyllum megalocarpum, **n. sp.**

Plant terrestrial and epiphytical, sarmentose; rhizome glabrous; *roots* and *rootlets* densely villous with long red-brown spreading hairs.

Stipes, ½–2½ inches apart on rhizome, 2–4 inches long, generally much shorter than the frond, cylindrical, glabrous, glossy, stout, wiry, flexuose, red-brown, sometimes greenish.

Frond, tri-quadri-pinnatifid, deltoid or deltoid-acuminate, 3–4½ in. long, 3–4½ inches broad at base, sometimes slightly acuminate, upright or slightly decurved, spreading, membranous, semi-pellucid, light-green, glabrous, not shining, not elastic; *pinnæ* and *pinnules* crowded, imbricate; *main rhachis* and *secondary rhachises* red coloured, winged throughout; *wings* crisped; *very young fronds* slightly scaly below with red-brown wrinkled deciduous scales on stipes and rhachis; *primary pinnules* opposite, falcate, lowermost pair deflexed; *secondary pinnules* sub-opposite and alternate, sub-secund, falcate, cuneate below, very thickly set, overlapping, outermost free.

Segments, or *lobes*, regular, narrow, linear, 1–3 lines long, width under ½ line, obtuse, entire, plane, terminal sometimes forked, very rarely elongate; *veins* prominent.

Involucres on lateral segments, very large, much wider than segments, $\frac{1}{12}-\frac{1}{8}$ inch wide at widest part, divided down to base, turgid, open, spreading and recurved, obconical, semi-elliptic, deltoid, and suborbicular, sometimes twice the size of the clusters of sori, entire, emarginate, sometimes slightly crenulate at apex, often geminate, sometimes two from one vein, and sometimes even three together.

Sori in large rotund clusters and coloured red, prominent, exserted, sometimes two clusters within one involucre; *capsules* very large, convex, glossy.

This species of *Hymenophyllum* is (as I take it) a striking and interesting novelty; owing to its large clusters of richly-coloured sori, and their still larger and spreading involucres or involucral leaves,—in their manner of growth almost resembling those of a small cabbage or lettuce around its heart,—and also with (in some places) its twin clusters of sori within one involucre, and arising from a single vein. I know of nothing like it among our many and varied species of *Hymenophyllum*; although this species is not so large as several of the New Zealand species of this genus, its clusters of sori and involucres are the largest that I know,—larger than those of *H. scabrum* and *H. dilatatum*. Its affinities, however, (though slight), are with the old well-known and

common species *H. demissum* and *H. polyanthos*, and with the new one *H. erecto-alatum*, particularly this last, and had its stipes been winged, and the wings there and on its rhachises subvertical and deeply crisped, as in *H. erecto-alatum*, I should have been inclined to have set it down as a variety of that species, notwithstanding its extra-large and peculiar involucres and sori. Apparently the smaller the frond the more profuse its sori, which in some small specimens is densely thick and heavy, and then contracting the whole frond. Its clusters of sori are also coloured bright-red when very young, long before they become mature.

Hab. In open woods, in the Seventy-mile Bush between Norsewood and Danneverke, both on the ground (but not growing thickly) and climbing trees—particularly the trunks of the tree-ferns, arborescent *Dicksoniæ*—1881, 1882.

IV. Asplenium, *Linn.*

Asplenium anomodum, n. sp.

Plant small, suberect, spreading; *caudex* very short and stout, scarcely any; *stipites* thickly tufted, 1–2½ inches long, rather slender, green, densely clothed at base with very large reticulated glossy black scales; *roots* fibrous, not long, compact, numerous, brown, thickly covered with short shining hairs; *fronds*, 4–6 (living ones) to each plant, 2–4½ inches long, 1½–2 inches broad, ovate-acuminate, pinnate, with a long terminal obtuse pinna subrhomboid-lanceolate, about 2 inches long or twice the length of the largest of the lateral pinnæ, with sometimes a small lobe at the base; *pinnæ*, 3–4 pairs, petiolate, distant, patent, alternate, rarely subopposite, 6–14 lines long, 3–6 lines broad, ovate, sometimes broadly elliptic, dimidiate, obtuse and rounded at apex, generally decreasing in size from the middle of the frond downwards; the base cuneate and excised below, and truncate and subauricled above; *colour* grass green, a shade lighter below; *margins* cartilaginous, coloured, and bluntly serrated, often only crenulate; *petioles* slender; *texture* membranaceous, glabrous above, scaly below on the veins with scattered long fine dark and scarious scales, having divaricating laciniæ at base (almost stellate), similar in texture to those at base of stipites, only very much smaller; *veins* apparent, subflabellate, simple, and forked, with no distinct costa, subclavate at apices and not extending to margin; *rhachis* slender, narrow, channelled above, and (with stipe) scaly, with long twisted dark scarious scales like those on veins of frond.

Sori generally few, distant, scattered, and very irregularly distributed, 1, 2, or 3 (and sometimes, though rarely, 5, 6) on a pinna, occasionally more, 8–18, on the terminal pinna; at first long, afterwards broad-elliptic,

thick and very prominent, and sometimes confluent, distant from both mid-rib and margin, but more so from the margin; *involucre* linear-oblong, whitish, very membranous and semi-pellucid; edge slightly erose.

Scales at base, black, glossy, deltoid-ovate very acuminate, 8 lines long, 1½ lines broad at base, reticulations large, subsphagnoid parallelogrammic, very conspicuous; margins entire and sparsely and irregularly fringed.

Hab. On decomposing limestone ridges, forests near Norsewood, *W.C.*; at Takapau, *Mr. J. Stewart*; and at Te Aute, *Mr. C. P. Winkelmann.*

This plant has some natural affinity with two of our well-known New Zealand species—*A. obtusatum* and *A. hookerianum*—although it widely differs from both in appearance; those two ferns also belonging to two very different sections of the genus. Were some of the characters of this fern not so discordant with those of either of the two aforementioned species, I should have classed it as a variety of one of them. It seems, however, to partake in several points of both those species, and may yet prove to be a step towards uniting them in a regular natural sequence.

It differs from *A. obtusatum* in the form of its pinnæ, especially the terminal one, in their texture and in that of the stipes rhachis and petioles, in colour, in venation, and in the form of its sori and scales. It is more nearly allied to *A. hookerianum*, in the texture of its frond and its venation, in the slenderness of its stipe rhachis and petioles, in the disposition of its lateral pinnæ, in its colour, and in its large (often solitary) sori, and scales; but differs in being only once-pinnate, with larger entire and simple regular pinnæ on shorter petioles, its very large terminal pinna, and thick stout tufted head or caudex. It has scarcely any natural affinity with another small New Zealand pinnate species or variety, *A. paucifolium*, Hook., (a plant I formerly obtained from those same localities), which is, I believe, a dwarf variety of *A. lucidum*. Its peculiar and beautiful large basal scales approach very near to those of *A. paleaceum*, Br., from Queensland, and to those of *A. sandersoni*, Hook., from Natal. The scales of this plant are truly wonderful objects under a microscope.

It is only after an extra large amount of study, examination, and research, that I have concluded to advance another new species of *Asplenium*; and I confess I should not have done so, had I not fortunately obtained an unusually large number of good specimens—not merely of single fronds but of entire plants—and their uniformity is great.

ART. XXXIX.—*On the large Number of Species of Ferns noticed in a small Area in the New Zealand Forests, in the Seventy-mile Bush, between Norsewood and Danneverke, in the Provincial District of Hawke's Bay.* By. W. COLENSO, F.L.S.

[*Read before the Hawke's Bay Philosophical Institute, 8th May, 1882.*]

OUR adopted country, the colony of New Zealand, has long borne a great name for its Ferns, owing, perhaps, as much to their being everywhere so common (exclusive of the ubiquitous brake fern, *Pteris esculenta*), from the lowest level on the sea-shore, its rocks and cliffs, up to nearly the highest point of vegetation on the alpine ranges,—as to their large number of genera or of species; although the surpassing beauty and novelty of some of them have justly served to raise their fame. In respect to their number of species, New Zealand is very far ahead of our British Islands, which only contain 48 species of true ferns; but then this truly natural order is but poorly represented in Europe. On the other hand, the neighbouring larger Australian colonies contain nearly twice the number of species hitherto found in this colony. In their natural state, the open plains and hills of New Zealand were almost everywhere covered with the common rusty-looking *Pteris esculenta;* and the woods were filled with numerous species and genera, not merely terrestrial, growing on the ground like other plants, and including several fine and famed arborescent species (commonly called tree-ferns), but also a good number of epiphytical ones, only found growing on trees, and then only in the deepest umbrageous and damp recesses of the forest; there, alike protected from winds and heat, and unvisited by animal ravagers in the shape of cattle, they flourished in charming profusion.

According to Dr. Sir Jos. Hooker's "Handbook of the New Zealand Flora," there were, at the time of its publication (in 1864), 120 species of ferns (exclusive of varieties) found in New Zealand, belonging to 31 genera. Of those 120 species, 5 should be deducted, as having been only hitherto detected in the off-lying islets in what is called the New Zealand botanical region, viz., the Auckland, Campbell's, Lord Howe's, and Kermadec Islands; thus leaving 115 species described in the "Handbook" as pertaining to New Zealand proper.

During the last few years I have made a practice of visiting the woods and forests of this district several times in the year, and on each visit have become more and more impressed with the almost unlimited resources of bountiful Nature—especially in her botanical productions, and particularly in what is called her lower forms, viz., of Cryptogams. It would require a series of papers, and that from far abler pens than mine, to give a mere list

of her manifold beautiful treasures in the natural orders of *Musci*, *Hepaticæ*, *Lichenes*, and *Fungi*, with which our New Zealand forests everywhere teem, not a few of which are still unknown to science; although a large number of them have already been published by Dr. Hooker in the "Flora Novæ Zealandiæ," and in the later work above-mentioned, and some others since in several of the later volumes of the "Transactions of the New Zealand Institute."

It has ever been a pleasing thought with me to consider what great, what new, what expansive ever-growing delight awaits the future generation of zealous nature-loving New Zealand naturalists in this particular branch of natural science. When the Mosses, the Liverworts, the Lichens, the Fungi, and the Algæ (including the invisible Desmideæ) of New Zealand shall have been, in the course of future years, discovered and drawn and accurately described,—much as similar botanical research and work has been done in our fatherland,—in the Hepaticæ of Sir W. Hooker ("British Jungermanniæ," and in "Musci Exotici"), and of Mitten; the Bryologia of Wilson; the Lichens of Babington, Lauder-Lindsay, and Leighton; the Fungi of Berkeley, Greville, and Cooke; the Marine Algæ of Professor Harvey; the Fresh-water Algæ of Hassall; and the Desmideæ of Ralfs*;—when this is all accomplished, as it ought to be under the increasing light of science (and so done it will be), then the generation of that day, and subsequent ones, will have much, very much, to be thankful for and to admire.

On the present occasion, however, I shall strictly confine my few remarks to some of the ferns of those woods, which, on various visits of mine thither, have caught and rivetted my attention.

In one spot in particular, deeply secluded in the quiet recesses of the grand old forest,—(a spot very dear to me! one which I have almost invariably visited several times, and every time with increasing delight, on each of my journeys inland),—I have repeatedly noticed and pleasingly contemplated a large number of species of ferns; more than I had ever seen growing together in all my wanderings in New Zealand; and all, too, flourishing luxuriantly. Within this circumscribed area of, say, one-eighth of a mile each way, or even less, I have found 48 species of ferns, and more,† belonging to 15 genera; or nearly half of the number given in the "Handbook" as being inhabitants of New Zealand proper. This, as I take it, is

* I am well aware of what has been so largely and efficiently done in all those natural orders by many eminent continental cryptogamists, as Schimper, C. Müeller, Hedwig, and Schwœgrichen, Gottsche, Lindenberg, and Nees, Acharius, Fee, and Nylander, Fries, Corda, and Tulasne, Agardh, and Kutzing, and others; but I have purposely confined my remarks to British cryptogamic botanists.

† *Vide infra*, including the lately-discovered *new* species.

surprising, bearing in mind that several of our described ferns are, as far as is known at present, particularly local; some species, indeed, having been only detected in one or two places, and there scarce; while others are chiefly confined to the South Island. Of all those rarer ones I give here a brief list, setting them down pretty nearly in the sequence of their scarcity, or of their little-known habitats.

Gymnogramme rutæfolia.
Nephrolepis tuberosa.
Todea africana.
Adiantum formosum.
Loxsoma cunninghamii.
Aspidium ocellatum.
  ,, *cystostegia.*
Nephrodium molle.
  ,, *thelypteris* var. *squamulosum.*
Asplenium richardi.
Cystopteris fragilis.
Lomaria pumila.
  ,, *fraseri.*
Trichomanes malingii.
Hymenophyllum minimum.
  ,, *lyallii.*
  ,, *unilaterale.*
Marattia salicina, and
Alsophila colensoi (in the North Island).

And this is still the more surprising (as we shall see) when we consider the entire absence from this small limited locality of some genera more or less common to different places in New Zealand which are not included in the above list—viz., *Gleichenia*, *Lindsæa*, *Cheilanthes*, *Doodia*, *Nothochlæna*, *Lygodium*, *Schizæa*, *Ophioglossum*, and *Botrychium*: of these nine genera half of them have but one species each (in New Zealand), and of the former brief list, six genera, also, each contain but one New Zealand species; so that, of the whole number of absent genera from that one locality (fifteen), no less than eleven contain only one New Zealand species each.

And here I may be permitted briefly to mention, for the especial benefit of my lady and young hearers, and also of strangers (if any) who have not yet realized the great advantages of diving into the depths of our New Zealand forests,—that to see our ferns in all their natural beauty, they should be visited in their cool sequestered retreats and bowers and grots at *two* seasons of the year, namely, in the spring and early summer, and in the autumn verging into winter. At the *first* of these two seasons many of them

will be found elegantly evolving their delicate new circinnate fronds,—the consummate grace and beauty of which no pen can adequately describe; while at the *second*, their mature fronds will generally be found loaded with fruit, all curiously and variously yet methodically arranged, according to their several natural genera. At the same time, I should observe, this natural evolution, perennial growing, and display, is, in some damp and suitable woods and spots, almost ever recurring.

And just as it is often with us in towns on especial occasions of meeting, —in the grave senate and in religious assemblies, as well as in the lighter ones of the concert, the ballroom, and the theatre,—the accessories, the environment, when in good taste and keeping, add much grace to the scene, the place, and the proceedings,—so it is at those two natural seasons I have mentioned. Nature must be seen in her various dresses, as well as in her different moods, to be fully appreciated. I well know that the mind only sees what the mind brings; or, in other words, it is the *feeling* that teaches or evokes the *true seeing;* for, whoever possesses the heart to feel will also have the eye to see. Bryant, an American poet, has a beautiful and truthful sentence (among many others) in the opening of his poem *Thanatopsis*, highly appropriate here—one that I have often thought on and repeated* (*solus*):

> " To him who, in the love of Nature, holds
> Communion with her visible forms, she speaks
> A various language."

I trust, however, to point out to you in a few short imperfect sentences, a little of what there—in those woods, in that great temple of Nature, and in that loved spot in particular of which I have spoken—are the principal and more striking botanical aids, and charms and draperies, pertaining to and surrounding that lovely natural fernery.

First, then, I should tell you there is a large open space in the forest, of an oblong or an irregular oval shape, sheltered from all high winds; the centre of this oval is pretty clear of trees, save two or three large and

* I may be permitted to make a brief allusion to my own invariable mode of acting on revisiting those grand old woods, where fancy leads me to imagine that the trees and plants, ferns, mosses, and flowers both recognize and smilingly welcome me. Although in my saying this I lay myself open to be laughed at rather than to be followed, " wearing my heart upon my sleeve for daws to peck at," I take off my hat and salute them feelingly, and so again on leaving them for the last time. I also take care not wantonly to break off or pull up to cast aside any specimens, and always tread carefully among the lovely ferns, mosses, etc. Feelings of a similar nature must have possessed the ancient Greeks, as well as the ancient New Zealanders, who always made a deprecatory speech, addressed to the guardians (or *genius loci*) of those grand old unfrequented woods, whenever they entered them to fell a tree for a canoe or any particular purpose.

ancient pines, whose huge and irregularly-buttressed trunks, and high, ridgy, uneven, and grotesque roots, all thickly dressed in climbing feathery ferns and other plants, add to the picturesque beauty of the scene. Here and there also, in the centre and in the foreground, scattered in clumps and standing singly, are several handsome tree-ferns, while the larger herbaceous ferns prominently show themselves in big tufts and masses, with the smaller ones growing thickly among them, and, as it were, under their sheltering wings. This is a very brief outline of the centre of that pleasing natural garden. It is not often that such a large and clear open space is to be met with in the midst of a thick forest. I daresay in that small piece of ground there are more than a hundred tree-ferns of nearly all sizes; some, as I said before, in the midst, and some intermixed among the trees and shrubs around it.

In the spring-summer season, in great plenty in the fore-back-ground, growing with the tree-ferns, that truly handsome shrub or small tree *Aristotelia racemosa*, is found in flower; this is one of the elegant trees of New Zealand, in its fine airy shape, in its variously coloured leaves, and in its profusion of lovely flowers, which, like the leaves, all vary in their tints and colours. With it also grow those three handsome small trees of the *Pittosporum* genus (*P. tenuifolium*, *colensoi*, and *eugenioides*), with their fancy-coloured elegant glistening leaves and dark purple blossoms; and with them fine old plants of the New Zealand *Fuchsia* (*F. excorticata*), which here attain to a large size, with their numerous variegated blossoms set off to advantage by their drooping silvery-lined foliage; with here and there among them that particularly healthy-looking shining green-leaved small tree *Drimys axillaris*, one of the gems of the shaded secluded forest!* Among them also, but more sparingly found, is the graceful twining *Parsonsia* (sps.), climbing and rambling over the lower shrubs and bushes, with its slender, nodding sprays of cream-coloured blossoms. Behind all those, in the background, and towering far above them, are the taller trees of *Plagianthus*, *Elæocarpus*, *Alectryon*, and *Knightia*, all differing largely in the forms and hues of their foliage, and all bearing in profusion their showy and curious flowers; while all around, standing out, as it were, in bold *alto-relievo*, and often rendered doubly conspicuous by their clean white bark displayed in large patches, are stately robust trees of *Weinmannia racemosa*, bearing their

* I don't know if any colonist (whether private gentleman or horticulturist), being an admirer of elegant and handsome shrubs, has ever attempted to cultivate this beautiful plant. Indeed, I doubt of its thriving, save in a very shaded, sheltered, and damp shrubbery. The beholding of this tree in its beauty has often served to remind me of the famed Plane-tree on the banks of the Meander, which, on account of its extreme beauty, Xerxes adorned with chains of gold, and assigned it a guard of honour, on his invasion of Greece.—(*Herodotus*, *Polymnia*, § xxxi.)

innumerable fine and drooping racemes of flowers, their long and stout spreading branches frequently descending low down from a great height in graceful curves, after the manner of growth of the horse-chestnut of our English parks; having growing in their topmost forks and branches the curious tufted long-leaved epiphytical plant *Astelia*, somewhat resembling huge crows'-nests, and serving to remind the English observer of a rookery; while from their upper trunks and limbs hang, in long drops and festoons, the handsome and showy species of climbing *Metrosideros* (*M. pendens* and *M. subsimilis*), with their pendent flowering branchlets terminating in beautiful tasselled bunches of white blossoms waving in the air; and still higher up, here and there, as if gazing down from its dark-green bowers, is the Spring Beauty of the Woods! the large-flowered lofty-climbing *Clematis* (*C. indivisa*), whose big white star-like sweet-scented flowers (often 4 inches in diameter), and many together in garlands and festoons high up in the trees by the highway-side in those forests, are the admiration of every traveller in the spring season. And, lastly, (to enumerate no more), on the ground, in the few open spaces between the larger and the tufted-growing ferns, is to be seen that graceful living green-matted plant, *Pratia angulata*, with its profusion of peeping curious snow-white flowers.

I should not, however, omit to tell you something, though briefly, of the many minor beauties of those secluded spots in the deep forests; of the numerous dear little gem-plants of the smaller Cryptogams,—the Mosses, the Liverworts, and the Lichens, which I have already in the beginning of this paper alluded to. For these, by their great number, their densely close compacted manner of growth, and every variety of shape and hue and colour, minute though they severally are, yet, united, form and present a most striking and interesting feature; while closely intermingled among them grow luxuriantly many of the smaller filmy and feathery ferns. The colours of many of them, especially of the Lichens, are both striking and vivid; generally displaying their organs of fructification, and fruits, in profusion, and to very great advantage; and then their elegant structure, so lovely and complex, and yet so simple, on closer examination, is wondrous. To see them on the large trunk of an aged tree, some scores,—or hundreds, it may be,—of those minute plants of many hues and kinds overlying one another, growing on and in each other (stratum super stratum) so that they cannot be separated without pulling them to pieces, and yet all alike living, healthy, and in harmony, where they have been so growing together for many years,—perhaps, in some cases, a century or more,—is both curious and pleasing, and brings strongly to recollection (as do also the bigger ferns and other plants flourishing

around) the modern well-known saying of "the survival of the fittest,"—where, however, *all* seem alike to be fitting. I have often thought, when contemplating a fine and beautiful patch of richly-coloured Cryptogams (like this I have just attempted to describe, or, rather, faintly to outline)—especially on seeing it in all its freshness, just after rain, and with the sun shining on it—that, should the art of fixing colours and hues in perfection by photography ever be attained, such a delightful living picture as this would assuredly early be taken, and excite great admiration, and not unlikely be largely copied in the way of mural house-decoration.

I give up all attempts at describing the few New Zealand birds to be seen there at this early season, although such greatly add to the living beauty of the scene. Prominently among them, if you keep yourself quietly hidden under the thick shrubs, is to be observed to perfection that eminently handsome and musical bird the tuii (*Prosthemadera novæ-zealandiæ*) flitting about from branch to branch in quest of honey, with its shining metallic plumage of many hues glancing in the sun, not unfrequently accompanied by a lively pair of the fan-tail flycatcher (*Rhipidura flabellifera*); and then there is the changing light of the sun itself, peering down through the lofty trees, ever and anon flecked and checquered by the passing summer clouds. One dear little black-and-white very small bird of the size of a canary (*Petroica toitoi*) I must however mention—not because of its great beauty or its song, for it is mute (or, at all events, although I have often seen it, I have never once heard its note), but because of its peculiar habit of inquisitiveness, or something of that nature; for, as sure as I have quietly seated myself to rest awhile or to examine a specimen, this little fellow will suddenly and quietly make his appearance, and hop up from twig to twig quite close, and then sit and watch intently (and with seeming gratification) all my doings. I have sometimes thought that he had previously been narrowly observing all my movements through the forest. At such times, too, queer fancies and old weird stories of the transmigration of souls, etc., come rushing into one's mind, and carry one perforce away with them to far-off thoughts of many things. Altogether it is a scene of surpassing beauty—to be contemplated in order to be well-conceived or believed.

In the later autumnal season all this living environment is changed—just as in our gardens and orchards, our shrubberies and woodlands—yet still beautiful; nature under another aspect—

> "Ever changing, ever new,
> When will the landscape tire the view?"

Now, around, at that same spot, instead of spring flowers we have autumn fruits, and though but small, and not belonging to the edible and useful

class, are, nevertheless, both striking and handsome as to colour; the charming and perennial (I was about to write everlasting) ferns continuing much the same.

First and foremost, at this season, to attract attention, are the hanging panicles of globular rich scarlet-coloured fruits of the twining and lofty climber *Rhipogonum scandens* (the "supplejack" of the colonists), their flowers in the spring season being much too small and neutral-coloured to be easily distinguished; the massy bunches of dark claret-coloured fruits, disposed in large spreading umbels, and half hidden under their still larger dark thick and quaint leaves, of the *Panax* (*P. arboreum*), which small tree also abounds there, are now very conspicuous; the flowers too of this tall shrub were not prominently seen displayed in the spring, for a similar reason with that of the last; the bright orange-coloured berries of the shining-leaved *Drimys axillaris*, always growing together in tiny clusters of three, now show themselves here and there on its coal-black bark branches;* the numerous black woody capsules, like little nuts, of the three *Pittosporum* trees (generally soon splitting broadly open into three equal valves), are now shown to perfection among their light-coloured and semi-translucent leaves; and, when in full fruit, and bursting, the highly curious and showy berries (*axils*) of *Alectryon excelsum*, somewhat resembling a red raspberry with a big glossy black eye in its centre (its seed); while the evergreen flat mat plant below, overrunning the face of the ground, the dear little humble *Pratia angulata*, which so coyly displayed its numerous white flowers in the spring and all through the summer, now shows in their stead its peculiar crowned fleshy carmine-coloured fruits, which, though (like its flowers) modestly half-concealed, will be sure to be quickly detected and noticed.

But I must no longer detain you, but proceed to give the promised list of the ferns I saw in that small plot of ground, which, indeed, is the main subject of my paper, but which alone is, I fear, to some, the driest part of it, unless they happily happen to know the ferns whose names are herein given; some of them, however, I have formerly exhibited here at our ordinary meetings.

* Having mentioned the "coal-black bark" of this pretty tree, I would also give in a note an after-thought (which has occurred to me since I left the forests), viz., that I scarcely recollect ever having seen its trunk and branches bearing any lichens or mosses, where almost all trees and shrubs (not having deciduous bark) bear them thickly in countless profusion: and the same peculiarity, I think, obtains with another small tree possessing piquant bark, viz., *Piper excelsum*. If I am correct in my remark, what is such a bare state, or lack of living drapery, to be attributed to? Can it be owing to the extreme pungency of their barks?

List.

Of *Cyathea*, 3 species—dealbata, medullaris, and smithii.
,, *Dicksonia*, 3 species—squarrosa, fibrosa (? "antarctica," *H.B.K.*), and lanata.
,, *Hymenophyllum*, 10 species—tunbridgense, bivalve, multifidum, javanicum, rarum, dilatatum, polyanthos *var.* sanguinolentum, demissum, scabrum, and flabellatum.
,, *Trichomanes*, 2 species—reniforme and venosum.
,, *Davallia*, 1 species—novæ-zealandiæ.
,, *Adiantum*, 1 species—cunninghamii.
,, *Hypolepis*, 2 species—tenuifolia, and distans.
,, *Pteris*, 4 species—esculenta, tremula, scaberula, and incisa.
,, *Pellæa*, 1 species—rotundifolia.
,, *Lomaria*, 4 species—procera, fluviatilis, lanceolata, and discolor.
,, *Asplenium*, 4 species—lucidum, falcatum, bulbiferum, and flaccidum.
,, *Aspidium*, 3 species—vestitum, richardi, and coriaceum.
,, *Nephrodium*, 2 species—decompositum, and hispidum.
,, *Polypodium*, 7 species—grammitis, rugulosum, pennigerum, rupestre, tenellum, pustulatum, and billardieri.
,, *Leptopteris* (or *Todea*), 1 species—hymenophylloides.

Total, 48 species of those published in the "Handbook."

Subsequently, 5 additional species (and one marked variety), all belonging to 4 of those same genera, have been discovered in that same small area of woodland by me, and described in the Trans. N.Z. Inst., vols. xi. and xii., viz. :—

*Cyathea polyneuron.**

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* As I was writing, primarily, on the number of those ferns published in the "Handbook N.Z. Flora" which I had found in this one spot, I purposely omitted any reference to this tree-fern (*C. polyneuron*) when remarking on the lovely scenery of that place; this plant being a recent discovery. But this large and graceful fern-tree, with its ample drooping fronds, adds much to the living beauty of that landscape.

One of the prettiest fairy-like scenes I ever saw in our New Zealand woods, I have, on more than one occasion, witnessed, when reclining on the grass under the shade of one of these tree-ferns. It was noon, and the summer sun was high, and the view, on looking up through the interlacing overhanging foliage softly waving in the breeze, was truly enchanting, every vein and veinlet being highly translucent [hence, I had very nearly specifically named it *translucens*], and then the green of its arched fronds was of such a delicate hue, such a truly sparkling living green without a blemish. The finely-marked ever-changing traceries, and glints and gleams of vertical sun-light peering down through the many myriad veins in that living bower, on those occasions, were far beyond language! At such times one no longer wonders at our forefathers deeming those evergreen recesses and bowers to be the beloved haunts of wood nymphs and dryads, fays, fairies, and pixies —a belief also firmly and pleasingly held by the ancient New Zealander.

Dicksonia sparmanniana.
Hymenophyllum erecto-alatum.
,, *pusillum.*
Trichomanes venustula.

Making in all a gross total of 53 species of ferns found growing together in a very small plot of ground, being several more than the whole number of species of ferns found in the British Islands. And I have good reasons for believing that the following additional species may yet be found there also, as I know they are growing in profusion not far off, viz.,—*Lomaria nigra, Polypodium cunninghamii, Adiantum diaphanum.*

Of one thing respecting this beautiful and justly-prized order of plants I feel pretty certain, namely,—that there are several still unknown and undiscovered species yet to be found in New Zealand.* For I am yearly becoming more and more convinced of the correctness of my old belief† in the very circumscribed locality of not a few of our New Zealand plants; and, therefore, as the many still unexplored mountains and valleys, forests and plains of New Zealand come to be visited and known,—especially to men of science,—their many botanical novelties will become known also; though I much fear that cattle and fire, and introduced plants, will certainly destroy many. Such, indeed, has been the case here already in not a few places in Hawke's Bay.

Art. XL.—*Descriptions of a few new Indigenous Plants.*

By W. Colenso, F.L.S.

(*Read before the Hawke's Bay Philosophical Institute, 9th October*, 1882.)

Class I. Dicotyledons.

Order XXII.‡ LEGUMINOSÆ.

Genus 1. **Carmichælia,** *Br.*

Carmichælia corrugata, sp. nov.

An exceedingly small glabrous *shrub*, 2–3 inches high; *branches* leafless, 1–2 inches long, 1 line wide, mostly simple, rarely forked, flat, linear, obtuse, striated (almost ridged) and grooved longitudinally, slightly flexuous,

* As a further proof, I may here mention that I have this year detected four new species of ferns,—two of them being also tree-ferns,—in another unfrequented portion of these grand old forests, some ten miles south of this spot; of which a full description will be given in a future paper.

† See "Trans. N.Z. Institute," vol. i.,—Essay "On the Botany of the North Island of New Zealand," § § 14, 22.

‡ The numbers here attached to both orders and genera are those of "The Handbook of the New Zealand Flora."

each branch bearing 4–5 alternate equidistant denticulations, each with a dry scarious ciliated bract. *Flowers* large, 3–4 lines long, purple with darker veins; *standard* pointleted; *wings* half the length of the standard; *style* bearded at tip; *peduncle* slender, 9–12 lines long, bibracteate, 1- (rarely 2-) flowered; *bracts* ciliated: *pedicel* 2 lines long, bracteolate at base; *calyx* large, broadly campanulate, more than 1 line wide, ciliate and hairy at margin, with 2 broad obtuse ciliated bracteoles adpressed at base; *teeth* very long: *pod* oblong-elliptic, 4–5 lines long (exclusive of beak), 1½–2 lines broad, turgid, corrugated on one suture (mostly the lower) with 8–9 thick closely formed wrinkles; *beak* straight, 1½ lines long: *seeds* rotund, 5 in a pod.

Hab. Dry stony plains, Renwicktown, near Blenheim, South Island; *Mr. F. Reader.*

This species, in its dwarf size and general appearance, resembles *C. nana*, but it differs widely from that species in its flower and pod; it is also not so robust a plant. In its peculiarly thick and wrinkled pod (whence its specific name) it differs from all the species of *Carmichaelia* known to me. Some of its short branches bear a flower from each notch or denticulation.

Order XXXIX. COMPOSITÆ.

Genus 1. **Olearia,** *Mœnch.*

Olearia marginata, sp. nov.

A robust *shrub* of low diffuse growth; branches, leaves, petioles, peduncles and heads of flowers thickly covered with tawny-yellowish wool: *branchlets* very stout, straight, smooth, and bare of leaves for 5–7 inches; *leaves* oblong, sub-obovate (sometimes roundish and narrow oblong), 2½–4½ inches long, 1¼–2 inches broad, very stout, entire, very obtuse and emarginate, tapering towards base, sub-verticillate, 4–9 crowded together at ends of branchlets far apart, sometimes (but rarely) a single pair opposite; *margined* all round above the upper surface for ½ line wide with thick wool; *midrib* thick and flat towards base, and densely woolly for about 1 inch from petiole; veined; *veins* prominent, opposite and sub-opposite, diverging and parallel, apparent on both sides; *veinlets* anastomosing; the upper surface of old leaves glabrous, glossy, pale yellowish-green; *petioles* very stout, ¾–1½ inch long, channelled above, much dilated at base and sub-clasping; young leaves densely covered with coarse wool, at first their upper surface is ash-coloured, but with tawny-yellow under surface and margins: *peduncle* very stout, axillary and sub-terminal, 2½ inches long, 3 lines broad, of a uniform thickness throughout, compressed, channelled, soft flexible not woody, drooping, with 3–7 leafy half-clasping sessile and decurrent bracts below the head; *head* (*alabastrus* globular) 1–1¼ inch broad, densely

imbricated in 7–8 rows; *outer scales* large, broad-oblong, obtuse, and with peduncle clothed with lighter reddish-yellow wool; *inner scales* 6–7 lines long, linear-lanceolate, acuminate, acute, longitudinally ribbed, glossy within; *receptacle* convex, 10 lines broad, deeply and coarsely pitted; *pits* square, the alveolar-like ridges even, a little higher at the angles.

Hab. Dry rocky hills, Renwicktown, near Blenheim, South Island. *Mr. F. Reader.*

This is in many respects a remarkable species, and is certainly pretty closely allied naturally to *O. insignis*, Hook., to which South Island species (unknown by sight to me) I was at first inclined to assign it, mainly through my not having specimens with fully opened flowers, and from their having been gathered in the known neighbouring localities of that plant. I had, however, several large specimens in full leaf, and with unopened heads of flowers nearly mature; and also an old head of the former year, but without a single floret remaining. On closely examining my specimens, I found them to differ in so many important points (*vide descrip.*, *supra*) from *O. insignis*, that I could hesitate no longer over them.

Its very peculiar and curiously margined leaves, together with their being subverticillate and densely clothed with coarse matted, almost floccose, wool,—and the soft flexible nature of its stout compressed and bracteate peduncles (which softness and flexibility they still retain in their dried state),—are striking characters.

In some particulars this plant has affinity with some of the Australian species of this genus.

Order XXVII. HALORAGEÆ.

Genus 3. **Gunnera**, *Linn.*

Gunnera strigosa, sp. nov.

Plant low creeping, very diffuse, rooting at ends of runners and forming nodes, 2–6 inches apart; *branches* terete, hispid, coloured brown. *Leaves* upright and spreading, radical from nodes, 5–14 arising from a node, darkish-green, rough with minute whitish points, ¾ inch diameter, cordate, auricled, 5-nerved, which are each again forked at the tips with veinlets, anastomosing, nerves red-brown and very prominent below, 5–7-lobed, lobes crenate, mucronate; petioles ½–1¼ inch long, somewhat stout, channelled; strigose with flat adpressed linear white hairs, which are sub-acute and apiculate, and scattered on both sides, particularly on midrib and nerves petioles and runners, which are sometimes quite hoary with them. *Flowers* monœcious on long slender scapes (or peduncles), 3–4 inches long, 2–3 times longer than the leaves, 2–5 scapes to a plant or single node. *Male flowers* above in a simple spike sometimes occupying ⅚ of length of scape, produced alternately and distant; *petals*, 0; *stamens*, 2, sessile

or nearly so above, but pedicelled and diandrous below, the pedicels of these few lower ones 1–2 lines long, a little longer than the filaments, with an ovate-acuminate concave bract at their base, and a pair of minute bracteoles at the junction of the filaments with the pedicel; the upper ones also each having three small bracts at its base, one outer and two inner; bracts and bracteoles sparsely ciliated; anthers broadly cordate, apiculate, thick, dark-coloured. *Female flowers* produced below at base of scape, and for a short distance up it, those at and near the base subpaniculate and subcapitate on short branchlets each containing 3–5 flowers on very short pedicels, crowded; those few above on scape sessile or nearly so and distant, each flower bracteolate at base much as in the male flowers; *ovaries*, ovate, glabrous, their 2 calycine lobes bearing a few white strigose hairs; *styles* 2, very long, three times or more the length of ovary, subulate, spreading, densely hairy (pubescent-hirsute), hairs light-brown, with some of the flat white strigose hairs scattered among them. *Fruit*, globular, about 1 line in diameter, glabrous, bright-red, bearing the two persistent calycine lobes of the ovary, which are divergent and black; *drupes* closely compacted into a head as big as a small cherry.

Hab. On clay banks in forest between Norsewood and Danneverke, Hawke's Bay district, North Island, flowering in November, 1881–1882: *W.C.*

Obs. I.—The broad white and flat hairs plentifully scattered over this plant attracts at first sight the eye of the observer; under a microscope they present a peculiar vermicular appearance. The pair of minute bracteoles at the base of the pedicelled filaments of the lower male flowers,—and also within the larger outer bract of the upper and sessile ones,—seem to supply the place of calyx, unless we consider the outer single and larger bract as such, and then those inner and smaller ones as petals. In two or three instances I have noticed a still larger single bracteole (resembling the outer bract) on one of the pedicelled stamens, immediately below the anther.

Obs. II.—As a species this plant has pretty close affinity with *G. monoica*, Raoul; but, although monœcious like that species, is quite distinct; this is very clearly shown by comparison with his own full description with plate containing dissections, as given in his *Choix de Plantes*, p. 13, *tab.* 8. It is also allied to another New Zealand species, *G. prorepens;* to the only Tasmanian species, *G. cordifolia;* and to the Fuegian species, *G. magellanica.*

ORDER XXXVI. LORANTHACEÆ.

Genus 1. **Loranthus,** *Linn.*

Loranthus punctatus, sp. nov.

A large bushy glabrous *shrub*, main stems 1–1½ inch in diameter. *Branches* terete, with light-grey bark filled with fine longitudinal cracks;

young branchlets semi-compressed, always dark red, very minutely roughish but not villous. *Leaves* opposite, decussate, distant, 6–8 lines apart, 1–1½ inch long, 6–8 lines broad, petiolate, broadly-lanceolate elliptic and sub-rhomboidal, obtuse, very coriaceous; colour a lively light green, both surfaces covered with very fine pale spots, midrib and veins obscure, primary veins opposite, veinlets reticulated, margins rough and coloured red with minute tubercles. *Flowers* light-vermillion red, single, suberect, expanding freely, 1¼ inch long, axillary on short stout peduncles. *Calyx-tube* conical, 2 lines long, limb very shallow, with 4 small teeth at the angles of the corolla. *Corolla* 4-angled at base and throughout two-thirds of its length, up to the insertion of the filaments, broadest at base, gradually contracted upwards, terete and swollen above. *Petals* somewhat linear, free, semi-transparent, 2 lines broad at base, constricted at one-third of length from apex and there 1 line broad, obtuse and subspathulate at top, and grooved within for the anther. *Filaments* stout, flat. *Anthers* long, linear. *Style* very long, longer than anthers, straight. *Stigma* dark red, globular, slightly cleft, and finely papillose.

Hab. Parasitical on *Fagus solandri* (and other trees), Forty-mile Bush, near Norsewood, Hawke's Bay district, North Island; flowering in November, 1876–1882: *W.C.*

Obs. I.—This is a fine bushy species, very full of branches, leaves, and flowers. It extends 5–6 feet each way in front from the tree in which it grows, and sometimes runs 9–10 feet in length, clasping the tree right round in several places, and thus appearing as if it were composed of two or three separate plants. Its leaves are usually disfigured with small round and raised hard swellings, which lumps appear on both sides, always punctured on the one side; sometimes 2–6–8 on a single leaf, the work of some insect.

Obs. II.—This plant has been long known to me, but, I fear, too often confounded with *L. tetrapetalus* (from my not having before seen it in its proper season of flowering, and through lack of close examination), to which species it is nearly allied, and in many respects closely resembles. Dissection, however, reveals its important differential characters, as given above.

ORDER LIII. SCROPHULARINEÆ.

Genus 7. **Veronica**, Linn.

Veronica trisepala, sp. nov.

Shrub small, glabrous, 2–3 feet high, with habit of *V. buxifolia*. *Branchlets* pubescent, transversely and regularly scarred 2 lines apart; hairs very thick and short, reddish, patent; bark light-reddish-brown. *Leaves* opposite, decussate, 4–8 lines long, 1½ line broad, glabrous, not shining, oblong-

lanceolate acute, sub-dimidiate, sub-falcate, entire with 2–3 cuts or slight notches on each side near apex, thickish, opaque, under a lens thickly studded with very minute white spots on the under surface, somewhat concave, veins obscure, midrib strong, not keeled, petiolate, petioles 1 line long, slender. *Flowers*, sub-terminal and sub-capitate in corymbs much longer than the leaves, on 2–6 axillary peduncles ½ inch long, peduncles and pedicels pubescent, each peduncle or rhachis bearing 6–8 branched-peduncles, each branched peduncle with 8–10 pedicels 1 line long, all bracteolate, bracteoles light-green, sessile, rather large, ovate-acuminate, obtuse and slightly ciliate. *Sepals* 3, about 1 line long, rather longer than tube, glabrous, very obtuse, margined, ciliate, upper sepal large and bifid. *Corolla* white with a faint tinge of light-blue, 4-lobed, spreading, 2½ lines long, 3 lines broad, lobes ovate, obtuse, tube under 1 line long. *Stamens*, *filaments*, and *style* equal, exserted, longer than corolla. *Stigma* simple. *Anthers* rather large, light-blue. *Capsule* (immature) 2 lines long, more than twice as long as the calyx, broadly elliptic, acute, flattish, glabrous, style persistent, long.

Hab. On the north end of Te Kaweka mountain range, near Napier. Discovered by *Mr. A. Hamilton*, 1881.

Obs.—This is another elegant shrubby species of this extensive genus, so well represented in New Zealand, and one that is so plainly distinct as not to be easily confounded with any other of our known and published species; its nearest relation is, I think, *V. diosmæfolia*, a tall slender northern species of widely different habit, and characters. I have little doubt of this plant becoming, also, a favourite in gardens.

Class II. MONOCOTYLEDONS.

ORDER I. ORCHIDEÆ.

Genus 1. **Earina**, *Lindley.*

Earina quadrilobata, sp. nov.

Plant, small, low, of densely compact growth. *Flowering stems* usually short and sometimes bare of leaves, erect and pendulous, 6–10 in. long, compressed, slender, woody, brittle, of a light brownish-white colour, irregularly blotched and spotted with black. *Leaves* sub-erect, narrow, linear, 2–3 in. long, 1½ line wide at broadest part near base, flat, acuminate, acute, alternate, distant, sessile, clasping, glabrous, sub-coriaceous, dark green, entire, margined with a white line which with the midrib are semi-translucent, peculiarly embossed or sub-keeled with a longitudinal impression (*in alto*) 2 lines long on midrib lower side, ⅓ in. from apex. *Flowers* distant, sub-distichous, nodding, in simple 5–6-flowered racemes or loose panicles, each scape bearing 3–4 slender and distant racemes, each flower bracteolate, bracteoles clasping, striated, obtuse with a point, or broadly sub-rhomboidal

with 3 teeth or points, the middle one being the largest and most produced,* usually an additional abortive flower arising from the uppermost bracteole; pedicels very short and slender included in the bracteoles; peduncle and sub-peduncles, 1–2 in. long, with 3 imbricated scarious bracts at base. *Sepals* and *petals* whitish with a primrose tint of yellow, membranaceous, nearly equal in length, 2 lines long; *sepals* erect obtuse, central one ovate, concave, margins entire, lateral obovate, margins irregularly and slightly jagged; *petals* a little larger than sepals, ovate-acuminate, obtuse, apiculate, sub-pellucid, strongly 1-nerved, slightly notched at margin; *lip*, sub-membranaceous, undulating and crisped, deflexed, 2 lines long, oblong-deltoid, 4-lobed, lobes sub-conniving, rotund, margins even, apices erose, sinuses broad, apex of lip deeply emarginate with a small central triangular recurved point or mucro (*emarginatus cum acumine*); *colour*, pure darkish-yellow (apricot colour), with a small blotch of purple-brown at base. *Capsule*, oblong, obtuse, 4 lines long, 1½ line broad, broadly ribbed and striated, glabrous, purple-brown; perianth persistent.

Hab. Among and on rocky boulders of conglomerate, immediate base of the Ruahine mountain range, east side, plentifully, but not in flower, 1845, where it grew in dense patches like grass; also, on open stony acclivities in sub-alpine forests, and epiphytical on trees, near Norsewood, district of Hawke's Bay, 1878–1881; flowering in November: *W.C.* Heights of Mount Kaweka, near Napier, 1882: *Mr. A. Hamilton.*

A species having close affinity with *E. mucronata*, but it is a much smaller and more graceful plant, with fewer and differently formed flowers.

Genus 2. **Dendrobium,** *Linn.*

Dendrobium lessonii, sp. nov.

Plant epiphytal and terrestrial; an erect and pendulous, diffuse slender shrub, often much-branched; *branches* 6 inches to 4 feet long, wiry, terete, hard, and brittle; main stems ⅓ of an inch in diameter; colour of stems and branches, some darkish-umber-brown, and some bright yellow, glossy and horny, ringed with dark scar-like joints, ½–1 inch apart, under the dry scarious sheathing leaf-bracts, which long remain. *Leaves*, alternate, ¾–1¼ inch long, 1–2 lines broad, 3–6 lines apart, sub-linear-lanceolate, or sub-ovate-acuminate, broadest near base, sessile, spreading, often falcate and twisted, coriaceous, semi-rigid, smooth not glossy, pale or yellowish green, margins entire, obscurely 10-nerved, midrib sunk and obsolete, somewhat concave, suddenly slightly thickened on the under side 1–3 lines from apex, with a slight corresponding notch in each side, tip obtuse, vaginant, sheaths

* This, however, is best seen on the maturation of the fruit, as the bracteole enlarges with it, and assumes a sub-calycine cup-shaped form.

truncate, longitudinally and regularly striated, and finely corrugated transversely. *Flowers*, white, membranaceous, few, scattered, usually 2 (sometimes only 1, very rarely 3) in a short loose raceme on a stoutish erect peduncle shorter than the leaves, always bursting at a right angle from the internode in the branchlet, and generally alternating with the leaves, never axillary nor opposite to a leaf; peduncle glabrous, shining, with 2–3 rather distant sheathing bracts, truncate and obtuse; pedicels, 2–3 lines long, bracteoles sheathing, acute; *perianth* nearly 1 inch in diameter, open, expanding, segments of equal lengths; *sepals*, ovate-acuminate, 5-nerved, margins entire, upper one the smallest, the 2 lateral ones with a very small round spur at their base; *petals* recurved, oblong-ovate, obtuse, with a minute point, margins also entire; *labellum* 3-lobed, the 2 lateral lobes small, oblong, obtuse, conniving, margins finely notched; middle lobe large, longer than broad, veined, sub-rotund (or sub-panduriform or broadly obovate), apiculate, margin sub-crenulate with a slight notch on each side, sides conniving, and 4 longitudinal elevated and shining green (or yellow-green), lamellæ near the base, which are bluntly toothed or crested; *column* slightly winged near apex, light green; *pollen masses* yellow. *Ovary*, 2–3 lines long, green, shining, obscurely striate.

Hab. In forests, Norsewood, Hawke's Bay district, North Island, high up in the forks of pine trees (*Podocarpus spicata*), and sometimes on the ground in dry stony hills under *Fagus* trees, flowering in November; 1879–1882; also among rocks near the sea at Cape Turakirae (the south head of Palliser Bay), 1845–6: *W.C.*

Obs. I.—The main branches of this plant are often very regular and spread out flat, bearing a bi-tri-pinnate frond-like appearance, from the side branchlets of equal length springing at about equal distances from the main stem; a few leaves on stout and strong young shoots are 1¾ inch long and 2½ lines broad; the branchlets and peduncles shoot alike erumpent at right-angles with the stem. Although I have (rarely) seen a raceme bearing 3 flower-buds, I have never seen one with all three open, the upper one seemed to be abortive; which is also often the case when there are but 2. In some flowers (on the same plant) the 2 lateral lobes and the extreme base of the middle lobe of the labellum, the throat and column, are dark pink; in a few others the same parts are slightly speckled with pink.

Obs. II.—I have long known this plant, and, though I early obtained specimens with a few unopened immature flowers from the rocks at Palliser Bay in 1845, and subsequently assiduously sought for good flowering specimens, I never detected any such until 1881, when my long previous suspicions of its proving to be distinct from the northern form (*D. cunninghamii*) were fully confirmed—I having well known and very often admired

and gathered that elegant species in its native forests, where it is often to be met with. There is much however at first sight, and with only immature flowering specimens, to confound this species with that plant; indeed, it is only by careful examination of several fresh specimens, dissection and comparison, that their specific differences are perceived, which are chiefly in the labellum, its form and the number and size of its lamellæ (which in *D. cunninghamii* are always 5); the colour, too, of its flowers is widely different, these are also smaller and much fewer in number, usually only 2 on a peduncle, and never assume the panicle form; and also its dwarf terrestrial habit.

Obs. III.—I believe this plant to be identical with the *D. biflorum* of A. Richard, which was originally discovered by Lesson, the naturalist of the French expedition under D'Urville, in Tasman's Bay, Cook Straits, in 1827, and published by Lesson and Richard, with a very full description and a folio plate, in 1832; and, therefore, I have great pleasure in naming it after its original discoverer. That New Zealand species, however, was confounded by them with *D. biflorum* of Swartz, (then a very little known species, discovered by G. Forster when with Captain Cook in the Society Islands), which species, though very nearly allied, bears only two lamellæ on its labellum. On R. Cunningham re-discovering* the Northern New Zealand plant, (which now bears his name,) it was described by Lindley with a plate,† as being quite distinct from the *D. biflorum* of Swartz. Lindley, however, believed Richard's New Zealand South Island plant to be identical with Cunningham's North Island one, *D. cunninghamii*. And I think that Sir J. D. Hooker, subsequently adopting Dr. Lindley's opinion, also believed Richard's South Island plant to be the same as our Northern one; which it certainly closely resembles at first sight in many particulars, although Richard's life-size plate with dissections shows a difference, particularly in its 4-crested labellum.

Genus 12. **Pterostylis**, *Br.*

Pterostylis emarginata, sp. nov.

Stem stout (nearly as thick as a goose-quill), erect, reddish (light brick-red), 10–16 in. high, 3–4 scarious bracts below, leafy in the upper half; *leaves* 6 in number, membranous, glabrous, shining, slightly spreading, alternate, 5–7 in. long, ½ in. broad, linear-acuminate, obscurely 2-nerved longitudinally, a little shorter than the flower, sessile, vaginant, very stoutly keeled, midrib thick 1 line wide, reddish. *Flower* membranaceous, striped white and green, rather large, 2–2¼ in. long including tails of sepals but excluding ovary, erect, lower lip of perianth ascending, ½ in. broad below

* It is said to have been originally discovered by Banks and Solander in 1769.

† Botanical Register, *tab.* 1756.

furcation, ending in two long and fine red tails 1¼ in. long, dorsal sepal with a very long red caudate apex much longer than the petals, and but a little shorter than those of the lower lip; *petals* somewhat falcate with a sharply produced abrupt angle on the upper edge, shortly acuminate and red-tipped, but without tails; *labellum* included, or but slightly exserted, oblong, emarginate, deflexed, 7 lines long, 3 lines broad, glabrous, membranous below and thickest at tip, striped green and white longitudinally with a dark red central line running towards tip, and there ending in a thick red callus not extending to margin; *appendix* more than 2 lines long, curved upwards, flat, bifid, and rather largely fimbriate (not villous), fimbriæ penicillate at tips; *column* taller than lip, wings large, each produced upwards in a long erect subulate point at the front angle, and downwards in an oblong auricle finely ciliated on the inner margins, white with a green transverse band. *Ovary* large, 1–1¼ in. long, sub-cylindrical, green, strongly 6-ribbed. *Tuber* large, white, rotund but much pitted and irregular, nearly an inch in diameter, resembling a very small and young round potato; rootlets several and stout, some proceeding from the stem 2 in. above the base.

Hab. In low forests, banks of streams descending from the east flank of Te Ruahine Mountain Range, 1847–1852; *W. C.*: also, in the forest at Te Aute, 1882; *Mr. C. P. Winkelmann*: and also in the forests at Hampden, 1882; *Mr. S. W. Hardy*: all localities in the Hawke's Bay district, North Island.

Obs. I.—A truly fine species having affinity with *Pt. banksii* (and long overlooked as belonging to it), but differing from that species in several important particulars—such as "*Pt. banksii*—leaves numerous, *produced much beyond the flowers, narrow, grassy: lip linear narrow; sepals and petals produced into very long filiform tails*"—FLORA N.Z.: and "labelli lamina *obtusa*"—BROWN, LINDLEY, CUNNINGHAM, etc., etc.

Obs. II.—The whole of this truly natural genus, as represented in New Zealand, wants skilful revision from living specimens, or from good floral specimens preserved in spirits; particularly with reference to the formation, etc., of the delicate wings of the column, which vary in the different species; and which, while well worked-up by Sir J. D. Hooker in his *Flora Tasmaniæ* (and subsequently by Bentham in his *Flora Australiensis*), seems to have been overlooked in both the *Flora N.Z.*, and the more modern "Handbook."

ORDER II. IRIDEÆ.

Genus 1. **Libertia**, *Sprengel.*

Libertia orbicularis, sp. nov.

Rhizome and leafy base of *stem* very short; *leaves* almost radical, suberect, membranaceous somewhat sub-rigid in age, narrow linear-acuminate,

10–15 inches long, ¼ inch broad, margined white, many-nerved, finely serrulate at tips. *Scape*, stout, erect, 12–22 inches long, 1½ line in diameter, closely marked throughout (together with panicle and bases of ovaries) with very fine and small longitudinal red lines, bracteated with 2 foliaceous bracts nearly equidistant, lowest bract 5–7 inches long, margins of bracts finely serrulated at tips. *Panicle*, loose, 5 inches long, bearing 12–18 flowers, disposed in distant sub-corymbose sub-panicles of 2–5 flowers, bracts ovate acuminate; *pedicels* ½ inch long, each with a small scarious bracteole at base. *Perianth*, ¾ inch diameter; *petals* white orbicular, 4 lines diameter, retuse at apex, unguiculate with a very narrow unguis, spreading, slightly concave; *sepals* 2 lines long, elliptic, obtuse, tufted at apex with a few small spreading hairs, concave, coloured green and pink on the outside; *stamens* stout, connate with styles about 1 line from the base; *anthers*, oblong-ovate, obtuse, yellow; *styles* flat, slightly channelled, spreading; *stigmas*, minutely penicillate. *Ovary* (immature) 5 lines long, triquetrous, broadly obovate, truncate at apex. *Seeds* (mature) globular, very slightly and minutely pitted.

Hab. Dry sides of stony hills, margins of forests, between Norsewood and Danneverke, Hawke's Bay district, North Island; flowering in November; *W. C.*: and, at Pohue, high hills near Petane, Napier; *Mr. A. Hamilton.*

A species having pretty close affinity with *L. ixioides* and *L. grandiflora*, but differing in its truly orbicular petals, tufted sepals, pencilled stigmas, globular seeds, and finely serrulate bracts and leaves; it also has affinity with the Australian species *L. paniculata.*

Order VII. LILIACEÆ.

Genus 3. **Cordyline,** *Comm.*

Cordyline diffusa, sp. nov.

A large tufted diffuse *herb.* *Leaves* suberect and drooping, 4 feet 8 inches—4 feet 6 inches long (including petiole), 2½ inches broad, lanceolate, acute, margins entire, flat or slightly revolute, striated, many-nerved (40 each side of midribs), veins oblique, subcoriaceous, glabrous, midrib very stout, white, wide and flat on the upper surface, green round and very prominent on the lower, and vanishing several inches below apex, when young membranaceous and of a pleasing green, but yellowish-green when old and much torn at the tips; petiole 8 inches long from base of contraction of the blade, very stout and clasping. *Scape* very stout 2½ inches in circumference, somewhat triquetrous at base, angular and channelled above, smooth. *Panicle* (several from same plant) suberect and drooping, 4 feet long, including scape which is 6–7 inches long to lowest branchlet), very loose lax and diffuse, broadly ovate in outline, composed of several scattered and alternate subpanicles, 18–20 inches long,

and 8, 6, 4 inches apart, each with a large foliaceous bract at its base, the lowermost bract being 2 feet 6 inches long. *Flowers* (unexpanded) on very short pedicels almost sessile, scattered on the upper parts of the simple and distant filiform and subflaccid branchlets, which are 3–7 inches long, (no flowers on their lower portions save one, sometimes two, in the axil of the branchlet), crowded towards the tips in spike form, apparently small, three lines long, white tinged with blue on the outside of perianth at tips, segments nearly equal, linear-oblong, concave, obtuse and incurved at apices. *Style* one line long, stoutish, somewhat channelled towards apex; stigma trifid, spreading, each tip slightly bifid and papillose. *Filaments* stout, short. *Anthers* yellow, long linear obtuse. Three scariose *bracteoles* at base of pedicel, the lowermost two lines long, nearly the length of the unexpanded flower, deltoid-acuminate, strongly one-nerved, the intermediate one small and often nerveless, and the upper one also small and one-nerved, nerves brown; sometimes the middle and upper bracteoles are united, and then they form one broad bicuspidate bracteole. *Ovary* (immature) glabrous, subrotund, slightly angled, many-seeded.

Hab. On cliffy exposed edges, dry hilly forests between Norsewood and Danneverke, Hawke's Bay district, North Island, 1881–1882; flowering in November: *W.C.*

Obs.—This plant grows in large clumps, much like the larger terrestrial *Astelia* (*e.g. A. fragrans*, mihi, *infra*), and the narrow-leaved species of *Phormium* (*P. colensoi*). It seems to have close affinity with *C. banksii*, (originally detected by me in the neighbouring forests), but is not arboreous like that species; as well as with *C. pumilio*, in the free disposition of its panicle and its herbaceous habit.

Cordyline sturmii, sp. nov.

Plant arboreous, 14–15 feet high, diameter of trunk at base 8 inches; *bark*—of lower trunk brownish and slightly rough and cracked,—of branches grey, smoothish, with darker regular markings from scars of fallen leaves, but not rough; branched at top in 3 long erect branches. *Leaves* very closely set and numerous, squarrose, broadly-lanceolate, acute, sessile, 2 feet 6 inches long, 4 inches broad at the middle, sub-membranaceous, tender, easily broken and torn by the winds, etc., margins entire, flat, slightly sub-revolute, apices of young leaves tightly rolled upwards (in-curved), wholly green on both surfaces, obliquely closely and regularly nerved, midrib 0, nerved over the place of midrib on the upper surface by fine longitudinal nerves, finely sub-striate, the blade decurrent gradually to the base, with no apparent petiole, and there 1 inch wide at the narrowest, and 1½ inch at the extreme base, which is dilated, thick, half-clasping and sub-articulated. *Flowers* in a sub-terminal compact thyrsoid-panicle, 20 inches long, 9 inches

broad, oblong, obtuse; rhachis and main branchlets stout, angled and channelled, glabrous, dark green, length of flowering stem below the flowers 5 inches, and 2½ inches in circumference, triquetrous, flat on top, sub-succulent not woody; *sub-panicles* rather distant on rhachis, not crowded, erect, alternate, disposed in a tristichous manner, each 6–9 inches long, axial branchlet always much the longest; *bracts* at bases of sub-panicles foliaceous, lowest 6½ inches long, 1 inch broad at the middle, ovate-acuminate, acute; *bracteoles* within bract at base of branchlet, short, broadly deltoid, acute, extending and sub-clasping around the base, closely including the 2–3 flowers there. *Flowers* numerous throughout on all the branches but not crowded, generally 3 together at lowest angle of junction of branchlet, 1 on each side and 1 above. *Flowers, short pedicels, and very small floral bracteoles* wholly white; *pedicels* bi-bracteolate; *bracteoles* very small, nerveless, less than a line long, the lower one deltoid acute, the upper somewhat cup-shaped and surrounding the pedicel on three sides, the margin irregular mostly with two small teeth or points. *Perianth* with a very slight greenish tinge on the outside before unfolding, 5 lines diameter, stellate; *segments* nearly equal, thickish, linear, obtuse, scarcely 2 lines long; *sepals* recurved; *anthers* linear, obtuse, small; *filaments* stout flat, linear, acute; *style* stoutish, cylindrical, slightly flexuose; *stigma* trifid; flowers fragrant. *Fruit* (ripe, of last year) reddish, glabrous, shining, bearing the persistent remains of the perianth, sub-globose, depressed at top, tri-lobed, 3 lines in diameter, each cell containing several (4–6) black, glossy, sub-reniform, sharply-angled and closely-packed seeds.

Hab. Forests, in the mountainous interior, near Lake Waikare, North Island.

Obs.—This fine new species of *Cordyline*, I may say, I have long known; and I ought to have described and published it before, having had ample living specimens, both flowering and fruiting, at command, in the nurseries of Mr. Sturm, at Clive, who, many years ago, brought the seeds of it from the mountain forests, and from them raised the plants in his gardens, where they have attained to a great height, if not to their full size. This description is mainly drawn up from plants of his own raising, aided by a young one of a few years old in my own garden, for the apices, etc., of the leaves, which in the larger plants are very rarely unbroken and torn. It is very distinct from any of our described New Zealand species of this genus, also from all other (known) published ones. A flowering panicle presents a fine sight, from the thick, solid, firm, and waxy appearance of its numerous white flowers, pedicels, and floral bracts, heightened by the dark-green back-ground of their stout glabrous branches. The leaves of this plant are very much broader and thinner than those of *C. australis*, and are, also, not

so erect above and drooping below, and present a much more squarrose and bulky appearance. Mr. Sturm very kindly brought me a large flowering branch from his tree, that I might have good specimens for examination and drying; I regret, however, that while it has some hundreds of leaves (a perfect crown) there is not one sound unbroken leaf among them! The stem portion of this branch brought to me is 2 feet long, 5 inches in circumference at the lower end, and 6 inches a little below the leaves; it is perfectly cylindrical and semi-succulent (something like a large and long cabbage stump), not woody, and has a smooth mottled ring, as described above; this branch was taken from the trunk lower down. Mr. Sturm further informs me that the said parent tree has annually for several years past produced one erect flowering panicle similar to this one (*supra*), only a little larger, and that the tree is now giving out several young branches (shoots) from above under its leaves, and also shoots from its trunk in various places; much after the manner of the other arboreous species of our New Zealand *Cordylines*.

I have very great pleasure in naming this plant after Mr. F. W. C. Sturm, its discoverer and fortunate raiser, who honourably deserves it; Mr. Sturm is a well-known botanist and very early energetic settler here on the East Coast and at Hawke's Bay.

ORDER VII. LILIACEÆ.

Genus 5. **Astelia**, *Banks and Solander*.

Astelia fragrans, sp. nov.

Plant terrestrial, large, robust, bushy, spreading, suberect, and slightly drooping at tops. *Leaves* linear-lanceolate, very acuminate, 6½ feet long, 2 inches broad about the middle, margins flat, entire, keeled, thickish (particularly at the main nerves), subrigid, glabrous on both surfaces, with a slight adpressed white scurf below, and some long loose white hairs at the bases, many-nerved, with 2 strong and thick equidistant red nerves or ribs more than 1 line wide running throughout, very stout, and largely prominent on both sides; colour light-green (and in age yellow-green), soon splitting and decaying at tips. *Flowers* in a panicle, dark green shining with purple segments, very fragrant, completely hidden among the leaves. MALE: *scape* 2 feet long, very stout, triquetrous, 3 inches in circumference, erect, 9 inches to first branch of panicle, shaggy at base, with loose white hairs, ¾ inch long, flat, membranaceous and longitudinally veined, clothed above with adpressed matted hairs; *panicle* stout, open, subpanicles alternate, lowest with 7 branchlets, next 6, next 5, and so on, everywhere dotted with minute purple dots, which extend to pedicels and perianth. *Flowers* numerous, 6–7 lines diameter; on short stout bracteolate pedicels, scattered on angled and loosely-shaggy racemose spikes, 3–7 inches long; *bracteoles*

on the tops of the spikes (in both *m.* and *f.*), much longer than their flowers; *lobes of perianth* closely reflexed to pedicel, large, ovate-oblong, obtuse, 2½ lines long, purple, finely striate, glabrous, slightly scurfy on the outside; *filaments* robust, 2 lines long, stellate, patent, white, succulent; *anthers* oblong, dark brown; *bracts* of subpanicles very large and spathe-like, ovate-acuminate, the lowermost 40 inches long, and 3 inches wide at base, largely ribbed and veined as in leaves, also thickly coloured with minute purple dots, making them to appear wholly purple at their bases, and closely clothed below on both sides with soft adpressed white hairs; *panicle and scape weighing* 17 *ounces.* Female: *scape* 15 inches long, erect and stout as in male, 6 inches to lowermost subpanicle, which, however, contains but 6 branchlets, and so on decreasingly with the others; *panicle* shorter and more compact than in male (more thyrse-like), branchlets much shorter, sub-compressed and less villous, almost quite glabrous, shining and wearing a subpapillose appearance, whole colour, including ovaries, a very dark green; *segments of perianth* very small, deltoid, obtuse, recurved, purple and striate as in male, the three outer larger than the three inner and imbricating at bases; *ovary* subrotund, ⅓ exserted, shining, slightly angular; *style* none; *stigmas* 3, large, distinct, orbicular, sessile, papillose; *barren anthers* very small, only just appearing at bases of segments; *bracteoles* purple and longer than in male; the whole female scape weighs 14 ounces, with ovaries immature.

Hab. In low wet boggy grounds, and on dry shady hillsides, in open parts of the forest near Norsewood, Hawke's Bay district, North Island, 1876–1882; flowering October and November: *W.C.*

Obs.—This fine plant has been long known to me in its general appearance, having often seen it; but never until this year did I obtain good flowering specimens. The flowers, however, are completely concealed within its thickly set and long bushy leaves; in this respect differing from most of the other known species of this genus. Their fragrant honey-like smell (of both *m.* and *f.*) is very pleasing and lasting, and no doubt serves to draw the smaller insects to them.

Order XI. CYPERACEÆ.

Genus 13. **Uncinia,** *Persoon.*

Uncinia horizontalis, sp. nov.

Culms 10–12 inches long, slender, smooth, triquetrous. *Leaves* numerous shorter than the culms, 9–10 inches long, 1 line broad, flat, margins scabrid, tips obtuse. *Spikelets* 1–1½ inch long, 2 lines broad, tristichous, upper 3–4 lines male; *bract,* 4–7 inches long, foliaceous, very narrow (almost filiform), canaliculated and nerved, margins scabrid, with very fine longitudinal scaberulous rows running below on the nerves. *Glumes* 3 lines long,

lax, ovate-acuminate, keeled, with a green longitudinal stripe down the centre (afterwards brown), slightly transversely wrinkled, margins white chaffy. *Utricle* smooth, as long as the glume, ovate-acuminate, 3-nerved, swollen in the middle; *bristle*, excurved, twice as long as the glume, light-brown.

Hab. In *Fagus* woods, Norsewood, Hawke's Bay district, North Island; flowering early in November, 1881: *W.C.*

Obs.—Plant wholly light green and very cæspitose, but spreading out flat in a circle, with the culms beyond the leaves.

Uncinia alopecuroides, sp. nov.

Plant, 2 feet 6 inches high, much branched at base, ascending, diffuse. *Culms*, 11–12 inches high, smooth, erect, leafy throughout with 4–5 leaves, trigonous (or multangular) with 3 raised longitudinal lines on each face. *Leaves* much longer than the culms, 1 foot 9 inches—2 feet long, 2 lines wide at widest part near base, linear, grass-like, flat, flaccid, very acuminate, dark green, nerved, striated, keeled, serrulate at margins, and finely and regularly scabrid on lines of nerves on both surfaces and on the midrib below, channelled towards tips, which are somewhat dilated and obtuse and thickly serrulated, at the base is a small broad sub-rotund bifid *ligula*; the short leaf-like bracts at the bases of the stems and the sheathing bases of the leaves are dark brown and regularly striated, the striæ broad and flat. *Spikelet* long, slender, terete, acuminate, 5½ inches long, the upper male portion 1¾ inch long, closely imbricated but less so at the base; *bract* of various lengths 1–5½ inches long, filiform, obtuse, 1-nerved, scabrid at edges and at the obtuse tip. *Glumes* narrow-linear-ovate, 2½ lines long, nerved, pale with a green central stripe, somewhat glossy, margins chaffy, tip membranaceous obtuse, white, with two brown crescent-like transverse bars, or bands, just below it. *Utricle* slender, lanceolate-acuminate, length of glume, pale, smooth; *bristle* longer than utricle, slender, pale, excurved. *Stamens* and *anthers* very long, linear. *Styles* spreading very rough (setose-like).

Hab. Forests, with the preceding species: *W.C.*

Obs.—From the form of its long spikelet, somewhat resembling that of *Alopecurus agrestis*, has been derived its specific name.

Genus 14. **Carex**, *Linn.*

Carex spinirostris, sp. nov.

Plant densely cæspitose. *Culms* leafy, obscurely triquetrous, slender, smooth, 10–11 inches long. *Leaves* much longer than the culms, 2 feet 6 inches—2 feet 9 inches long, ⅙th of an inch wide, linear-acuminate and very acute at tip, rather flat, sub-membranaceous, striate, keeled, drooping, dark-green, slightly scabrous, with finely and closely serrulated margins. *Spikelets*

7, slender, cylindrical, rich reddish-brown; 3 lower very distant, nearly 2 inches apart, 1½ inch long (or more), and compound or subpanicled, unisexual, *female*, save 1 or 2 *male* flowers at the base, nodding; 4 upper crowded and shorter (except the top one which is 2 inches long), unisexual, *male*, but having a few *female* flowers at the top of spikelets. *Bracts* very long, 2 lowest foliaceous and much longer than the culm, the upper ones setaceous and reaching to about the length of the culm, all very scabrid; each bract having a pair of long membranaceous linear-oblong bracteoles (or sub-ligulæ) at base and clasping the peduncle. *Peduncles* filiform, wiry, angled, and scabrid. *Glumes* oblong, much longer and broader than the utricle, shining, truncate, and fimbriate at tip, nerved, edges membranaceous, cuspidate or awned, the beak, or awn, stout, green (some white), very long (1 line, and some more), very coarsely barbed. *Utricle* glabrous, sub-oblong-ovate, brown, bicuspidate, cusps spreading, barbed. *Stigmas* 3, light-brown, rough, half-exserted, spreading at tips. *Filaments* and *anthers* very long; *filaments* white, flaccid and much wrinkled; *anthers* linear, apiculate at tip, reddish-brown.

Hab. In *Fagus* forests, near Norsewood, with the preceding *Unciniæ*: *W. C.*

Class III. Cryptogamia.

Order V. HEPATICÆ.

Genus 30. **Symphyogyna,** *Mont. and Nees.*

Symphyogyna biflora, sp. nov.

Plant, terrestrial, gregarious, each plant simple, erect, stipitate, the largest under 1 inch long; roots short hairy; *stipe* 4–6 lines long, sub-flexuose, compressed, winged above, 2-nerved from the base of frond; nerves very distinct; *frond*, decurrent on the stipe, 3–5 lines long, 7–9 lines broad at base, mostly branching at base into two main divisions, each division once or twice dichotomous, symmetrical, kidney-shaped in outline, sometimes palmate, glabrous, pellucid, very finely reticulated; *colour*, light-green; *segments* linear, or linear-spathulate, 1 line broad, very obtuse, rounded at apex, deeply emarginate with sides conniving, nerved to base of notch, margins finely serrate; teeth long falcate and transversely barred; sinuses rounded; *fructification* in axils of nerves near base of frond beneath, generally two on each plant, symmetrical; *involucre* a small narrow oblong scale in front of calyptra, jagged at margin; in a few of the largest plants, two additional involucres have been noticed, one at the base of each upper pair of nerves: *calyptra* tubular, 3–3½ lines long, bifid at apex, margins fimbriate: *peduncle* 1 inch long, erect, chartaceous, white: *capsule* 2 lines long, linear-oblong, cylindric, acute, 4-valved, abounding in long elaters; *colour*, rich red-brown.

Hab. On clayey banks, "Seventy-mile Bush," between Norsewood and Danneverke: *W.C.*; Glenross: *Mr. D. P. Balfour*; (North Island): near Blenheim (South Island): *Mr. F. Reader.*

Although at first sight this species may appear very near to *S. hymenophyllum*, *S. flabellata* and *S. leptopoda*, and also to my new species *S. rugulosum*, there are many points of distinction between them. It is a much smaller plant with a shorter stipe, each simple frond being also a perfect plant and not rising from a creeping rhizome,—which those four species severally do. It further differs from *S. flabellata*, *S. leptopoda*, and *S. rugulosum*, in having serrated margins; and from *S. hymenophyllum* (which has serrated margins), in its serratures or teeth being much larger and closer, and in the divisions and outline of its frond, in the shape of its segments, their apices and sinuses, and most distinctly in its very minute areolation. Fortunately I have been able to examine a large suite of specimens, from Hawke's Bay district, and from Blenheim (South Island); and am also well acquainted with all the known New Zealand species of this genus.

[*Obs.* In describing the fructification, I have added this word—"beneath"—for clearness; although it properly belongs to the generic description, which character, however, is not given in its place, in the short description of the genus in the "Handbook," nor in the "Flora of New Zealand." From my too closely following what is said in the "Handbook,"—at the close, under "Additions, Corrections," etc.,—"a new arrangement of the New Zealand genera of *Hepaticæ* by Mitten," (p. 752)—I fell into an error three years ago in describing, or rather in partly naming, another new and closely allied species, *S. rugulosum*, mihi;* as there the genus is shortly characterized by Mitten as having the "Calyptra on *upper* side of often stipitate frond," which, of course, can only mean its *ventral* surface; and *Metzgeria*, the next genus in sequence, is said by him to have the "Calyptra on the *under* side of frond." Sir J. D. Hooker, however, in his "Key to the Genera of the New Zealand *Hepaticæ*," ("Handbook," p. 500), gives as a character of this genus,—"Involucre a toothed scale *dorsal*:" and so again, in his "Flora N.Z.," vol. ii., p. 127,—*Symphyogyna*, Calyptra *dorsal*, etc.:" and in his "Flora Tasmaniæ," vol. ii., p. 239, he further says, under *Symphyogyna rhizobola*, (which had also been erroneously described by Dr. Taylor as having its "Calyptra *ventral*,")—"the fructification is truly *dorsal*, as in all others of the genus." And so it is stated in the "*Synopsis Hepaticorum*": but all this I did not fully know three years ago, until after I had described *S. rugulosum*, (although at that time I had doubts about it, as my paper will also show), being led astray, as I take it, by the latest published authority on *Hepaticæ*.]

* "Trans. N.Z. Inst.," vol. xiii., p. 368.

Genus 41.* Monoclea, *Hook.*

Monoclea hookeri, sp. nov.

Plant procumbent, frondose, imbricated, very flat, thick, succulent, densely rooting all over lower surface; colour grass-green. *Fronds* very large, spreading, plane, apparently continuous, glabrous, hairy below and at the edges; lobes unequal, of all sizes and shapes, often largely crenulate and subrotund at margins, which are sinuate and undulate. *Calyx* none. *Calyptra* (or *perianth*) membranaceous, greenish-white and transparent, tubular, 4 lines long, 1 line broad, slightly bilobed and jagged at tips, lips very obtuse, wholly included within the cavity of the frond, which is near the margin on the upper surface, where it remains enclosing the base of the seta. *Seta* 1¼ inch long, 1 line broad, linear, terete, stout, succulent, glabrous, whitish, erect from frond, but the part included (with the calyptra) is horizontal, sometimes 1, 2, or 3 issue from the same simple fissure, and are disposed closely together flat and parallel within the frond, without any prominent ridgy markings on its surface to denote them. *Capsule*, terete, at first (before bursting) linear-oblong, obtuse, erect, 2 lines long, dark brown, smooth, glossy, without striæ or markings, bursting below longitudinally, when the margins become revolute, and the spores and spiral filaments show themselves in a small floccose woollylike mass, their colour a dirty light-ash-yellow; afterwards the empty capsule spreads out and assumes an oval figure, the texture being very finely reticulated.

Spores and elaters are numerous, closely resembling those of *M. forsteri*. I could not detect any vestige of a columella, the want of which (as first shown by the founder of the genus, Sir W. J. Hooker) has been by some disputed.

Hab. In damp forests on the ground, on the immediate margins and sides of streamlets, near Norsewood, Hawke's Bay, 1882: *W.C.*

Obs.—This plant is very common throughout New Zealand—almost sure to be met with on the borders of watercourses and springs in shady low-lying woods—but very rarely in fruit. Indeed I—who have known it in its barren state for nearly fifty years, and have very often diligently sought its fructification—never saw its fruit before I found these specimens; and I was mightily pleased at my discovery. Although I gained several fruiting specimens, yet these all grew in one small spot (and, apparently, from one plant), I could not find any more though there were feet, or yards, of this plant luxuriantly growing there. I had always supposed this plant to be

* This genus does not appear in the "Flora N.Z.," neither in the "Handbook Flora N.Z." (as it was not known to inhabit New Zealand). I have, therefore, numbered it to come after *Riccia* (Gen. 40), the last genus of Sir J. D. Hooker's *Hepaticæ;* although I am aware that the authors of the *Syn. Hepaticorum* place it before *Marchantia*.

identical with Forster's plant (*M. forsteri*, Hook.), which was discovered by him when with Cook somewhere in the "Southern Islands,"* and of which no specimens have been obtained since Forster first gathered them. This species, however, though possessing close affinity with that, bears a different shaped capsule, which is not striate or marked longitudinally as that is, its calyptra also is differently situated, and has different lips, and there are other differences in its frond.

I have very much pleasure in naming it after the late Sir W. J. Hooker, who established the genus, and who correctly described and drew the original plant in his justly celebrated *Musci Exotici* (vol. ii., tab. 174), so that the names of those two honoured botanists may remain together in connection with this small abnormal and highly curious natural genus, which now contains 2 species.

ART. XLI.—*Additions to the Flora of New Zealand.* By JOHN BUCHANAN, F.L.S., of the Geological Survey Department.

[*Read before the Wellington Philosophical Society, 9th December,* 1882.]

Plate XXVIII.

Hymenanthera traversii, Buchanan.

A SMALL glabrous, branched, shrub-tree. Branches rigid, reddish-brown, rough, with viscid secretion; leaves coriaceous, alternate, olive-green, shortly petioled, ¾–1 inch long, obovate, obtuse or acute, covered closely on the back with small silvery-white tubercles, margins reflexed, venation obscure, midrib distinct, stipules very small.

Flowers very small, solitary, in the axils of the upper leaves; pedicels short, curved, with small bracts at base; calyx cupular, entire; petals ⅛ inch long, linear obovate or linear oblong, obtuse.

This addition to the flora of New Zealand was discovered in the bush, Collingwood district, Nelson, by Mr. H. H. Travers, while on a recent visit there. As an ornamental foliaged plant it may be commended, but from its diminutive inflorescence it can hardly claim a place in the flower border.

Plate XXVIII, fig. 1, portion of branch nat. size; 1 *a*, flower enlarged; 1 *b*, petal showing glands.

Metrosideros parkinsonii, Buchanan.

A large robust climbing shrub with the terminal twigs 4-angled, whole plant glabrous. Leaves distichous, shortly petioled, 1½–to 2 inches long, oblong-lanceolate acute, midrib prominent, lateral nerves indistinct. Flowers numerous in robust little cymes which grow from the branches,

* "In Insulis Australibus." (*Forster in Hb. Lambert*).

but are never axillary to the leaves, peduncles and pedicels rigid, stout. Flowers, including stamens, 1 inch long. Calyx pyriform widening at the mouth and produced beyond the ovary, lobes triangular, petals large, bright-crimson, oblong acute, lacerate on the margins, stamens and style stout. Ovary adherent only at base to the calyx-tube. Capsule 3-valved, upper part free.

This plant differs from *M. hypericifolia* (to which it is allied) in its larger size, upright habit of branching, smooth bark, and position of capsule in the calyx. From *M. colensoi* (to which it is also allied) it differs in the cymes never being axillary to the leaves, and in the free position of the capsule in the calyx-tube.

Named in honour of Mr. Sydney Parkinson, botanical draughtsman on Captain Cook's first voyage to New Zealand. Collected in the Collingwood district, Nelson, by Mr. H. H. Travers, December, 1882.

Plate XXVIII, fig. 2, plant nat. size; 2 *a*, floret; 2 *b*, petal enlarged.

Calochilus paludosus, R. Br.

The present plant adds yet another genus of *Orchideæ* to the flora of New Zealand.

It was collected by Mr. H. H. Travers in the Collingwood District, South Island, in December last. Baron F. von Müeller, to whom specimens were sent, says: "I took immediate notice that this *Calochilus* might be identical with *C. paludosus*, as you suggest, but the inner segments of the calyx are shorter, and the anther is less blunt; still, that may be ascribed to variation, and I must confess I am not clear about positive distinction between *C. campestris*, *C. robertsoni*, and *C. paludosus*, perhaps because only one form seems to have come under my notice in Victoria in the fresh state, and the others I know only from dried and not very instructive New South Wales specimens. It would be well if a little more material of the New Zealand congeners could be procured, and best of all if several flowers were put fresh into alcohol."

Art. XLII.—*Notes on some of the Diatomaceous Deposits of New Zealand.*

By John Inglis.

[*Read before the Philosophical Institute of Canterbury, 30th November, 1882.*]

Plate XXIX.

For many years past I have been interested in and have devoted some attention to diatomaceous deposits from various parts of New Zealand, and propose in the present paper to give an account of some of them, with, it may be, a somewhat incomplete list of the species which have been found therein.

1. HYMENANTHERA TRAVERSII, Buchanan.
2. METROSIDEROS PARKINSONII, Buchanan.

J.B. del. et lith.

Lake Sumner, North Canterbury.

About ten or twelve years ago Mr. John Russell, then of Lake Sumner Station, observed on the margin of a tiny rill, on his run, on the hill slopes, on the southern side of the lake, and about two hundred feet above the present water-level, some dry whitish lumps of earth, which he brought to Christchurch and submitted to the inspection of Dr. von Haast and me. Dr. von Haast informed him of its diatomaceous character, and as I had the opportunity of visiting the neighbouring station shortly afterwards, I arranged with Mr. Russell to visit the spot. I found the vegetable mould and deposit cut into by the rill to the depth of two or three feet, laying the latter bare. The terrace land falls back at this point from the lake, and taking an easterly sweep, at an elevation of about three hundred feet, towards the "Big Brother" Mountain, allows space for Lake Katrine, and opposes a barrier to the discharge of Lake Sumner, with which it is connected by a narrow channel, in that direction. The waters of Hurunui River pass through Lake Sumner, and discharge themselves between the farther side of the "Big Brother" and the mountains on the Nelson side of the river, and through a huge clay bank. It appears therefore probable that this deposit has been made at a long past period of the lake's history, when its level was much higher than it is at present.

The deposit is very rich in many fine forms, and two species new to science have been found in it. On various occasions I have supplied samples of the earth, and some of them have found their way into the hands of English diatomists, and through their instrumentality the new forms have been described.

Triceratrum trifoliatum, Cleve, n.s.

This form is unique and very remarkable. It is figured and described in the "Royal Microscopical Journal" for June, 1881, by Dr. Stolterforth, under the name *Hydrosera tricoronata* as obtained "from a sub-peat freshwater deposit, North Canterbury. The exact locality not known." I have ventured to suggest its lacustrine origin.

The description given by Dr. Stolterforth is as follows:—

"Filamentous. Front view of valves nearly quadrangular, showing four ridges and a deep central depression, distinct connecting band; side view trilobate, each lobe having three projections or minor lobes. The lobes are finely dotted, no regular markings on the central hexagonal portion."

Professor Cleve has also described the species shortly prior to Dr. Stolterforth, hence the name attached.

Plate XXIX., fig. 1, *a* side view, *b* front view.

Surirella contorta, F. Kitton, n.s.

This species is supposed at present to be peculiar to New Zealand, and besides appearing in Lake Sumner deposit, it is found in deposits from Manawatu and Whangarei. Mr. Kitton described it in the Monthly Microscopical Journal for November, 1874, as follows:—

"Valve elliptically or slightly ovate, canaliculi fine, numerous; alæ inconspicuous, narrow median elevation terminating in short spines, surface of valve obscurely striate, valve in front view contorted."

Plate XXIX., fig. 2, side view.

Stauroneis (or *Pleurostauron*) *fulmen*, Brightwell, n.s.

This form is very scarce in the deposit, but was found quite recently by me in quantity in freshwater at Ngapari, Fernside, and was described as *S. huttonii* in a paper I read at a meeting of the institute on the 4th May as follows:—

"*Front view* oblong, with a marked depression at the line of suture, length rather more than six times its breadth. *Side view*, with three inflations on both sides, those at each end slightly less than those in the middle, valve narrowing towards the ends, which are obtuse. *Stauros*, linear, dilated towards the margin of valve, reaching the margin. *Length*, ·008 of an inch."

I subsequently found that it had been figured and described in almost identical terms in the Proceedings of the Royal Microscopical Society, volume 7, page 179, by Mr. Brightwell as "freshwater, Melbourne." I have accordingly withdrawn the paper.

Hab. Freshwater, Melbourne; Ngapari, Fernside; *fossil*, Onehunga; Lake Sumner; Amberley.

Plate XXIX., fig. 3, *a*. front view, *b*. side view.

Of the three species just described—specially New Zealand forms—I have thought it desirable to reproduce the figures.

The following is a list of the species already found, for which I am indebted chiefly to the kindness of Mr. E. Grove, of Saltburn, England:—

Epithemia zebra, *var.* proboscidea.
  ,, sorex.
  ,, gibba.
  ,, turgida.
Eunotia prærupta *var.* bidens.
  ,, diodon.
  ,, eruca (amphicampa).
Eucyonema gracile.
  ,, cæspitosum *var.*
Amphora ovalis.
Surirella splendida.
  ,, contorta, *n. s.*

Triceratium trifoliatum.
Nitzchia spectabilis.
,, amphioxys.
Navicula cardinalis.
,, major.
,, viridis.
,, commutata.
,, divergens.
,, hemiptera.
,, placentula.
,, firma *var.* amphigomphus.
,, ,, *var.* subampliata.
,, bacillum *var.*
,, elliptrica.
Gomphonema constrictum.
,, clavatum.
Stauroneis (Pleurostauron) fulmen.
,, ,, frauenfeldii.
,, ,, javanicum.
,, ,, acutum.
,, phœnicenteron.
Melosira orichalcea.
Cymbella scotica.
Pinnularia punctulata.

Wainui, Akaroa Harbour.

This freshwater deposit is extensive and so pure as to render it suitable as an article of commerce. The following species have been already found:—

Epithemia ventricosa.
,, musculus.
,, proboscidea.
,, longicornis.
Synedra ulna.
Odontidium mutabile.
,, ,, *var.*
,, tabellaria.
Pinnularia nobilis.
Cymbella affinis.
Melosira punctata.
Eunotia arcus.

Dunedin.—Green Island.

This is a freshwater deposit taken from a railway cutting near Green Island, and is chiefly composed of—

Eucyonema cæspitosum.

Cust Valley, North Canterbury.

I discovered a small pocket of this sub-peat deposit, about five years ago, which consisted chiefly of the doubtful genus *Amphicampa*, and was

described by me, in vol. xiv. of the Transactions of the New Zealand Institute, as *Himantidium maskellii.* Mr. Brightwell describes a specimen from Melbourne under the name *Eunotia eruca.** The leading diatomists of England now include *Amphicampa* and *Himantidium* under the genus *Eunotia.* Subsequently I found other deposits in the same swamp, and note the species found as follows :—

Eunotia eruca.
,, bidens.
,, undulatum.
Stauroneis cruciculum.
,, phœnicenteron.
Pinnularia major.
Gomphonema constricta.
,, viridis.
Synedra radians.
Surirella linearis.
Orthosira orichalcea.
Epithemia longicornis.
,, turgida.

Amberley, North Canterbury.

On the property of Mr. Alex. Broadfoot, Seaview, at a point on the top of the terrace where until lately there was a spring of water, I found a considerable deposit, and in the peat swamp below I found the following fresh-water species :—

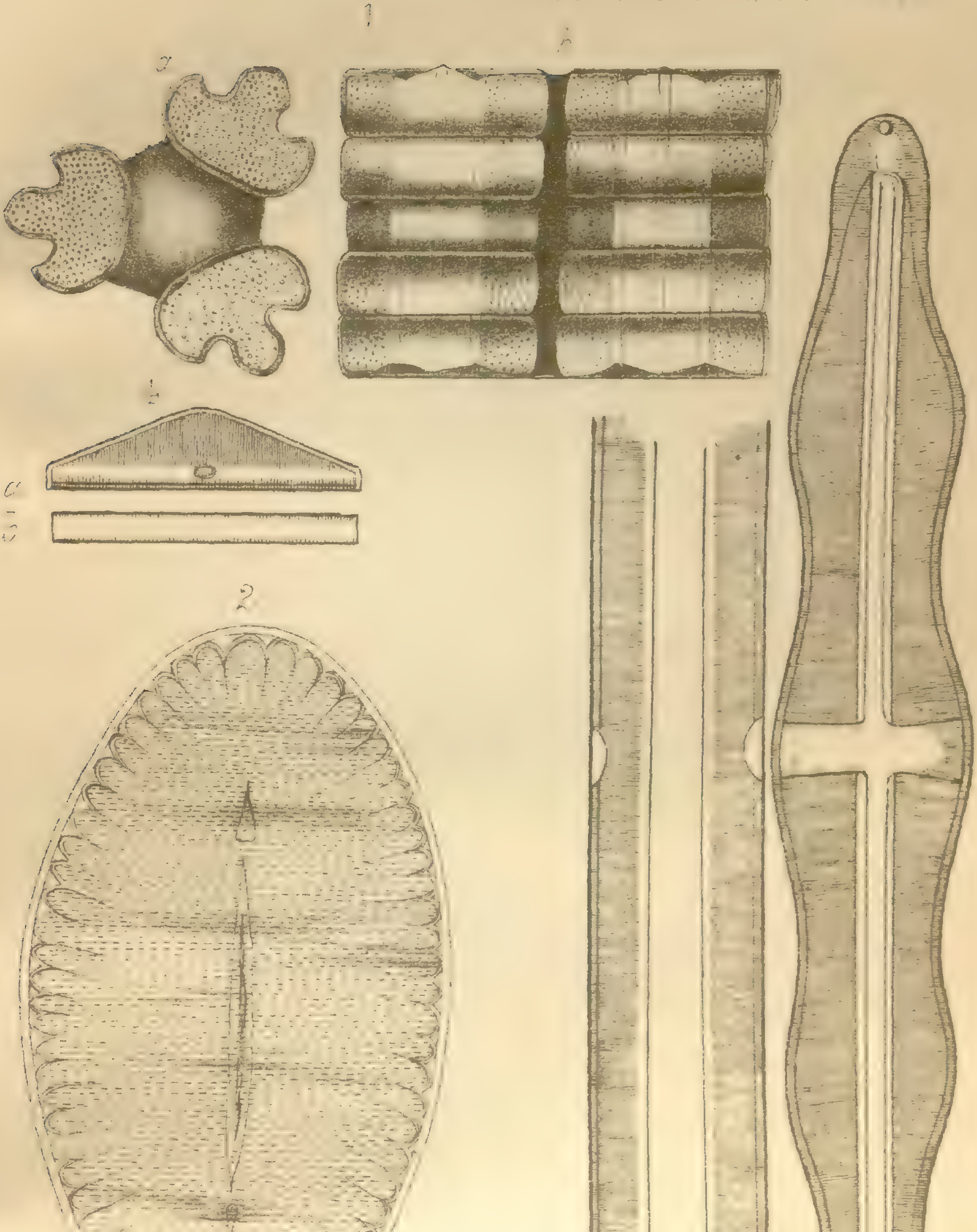
Stauroneis (Pleurostauron) fulmen.
Eunotia eruca.
,, triodon.
Melosira punctata.
,, ,, *var.*
Synedra vulgare.
Pinnularia acrosphœnia.
Eunotia (Himantidium) bidens.
,, arcus.
,, undulatum.
,, pectinale.
Gomphonema constrictum.

New Brighton, near Christchurch.

A fresh-water and possibly brackish-water deposit was laid bare by the formation of Paynton's road through the swamp. I have been able to identify the following forms :—

Pinnularia major.
Navicula munda.
,, didyma.
,, elliptica.

* "Quarterly Journal of Microscopical Science," 1859, p. 179.



DIATOMS.

J. Inglis, del.

Cymbella ? Pl. XXIX., fig. 4; *a*, side view; *b*, front view.
Coscinodiscus ?
Homœocladia sigmoidea.
Synedra gallionii.
Surirella limosa.
Epithemia argus.
,, sorex.
,, zebra.

Macintosh Bay, Banks Peninsula.

On the hill-slopes of the bay, a visitor noticed after rain that the water trickling from the side of one of the spurs left a white deposit on the grass, some of which was gathered and placed in my hands for examination. I endeavoured to get the position of the deposit fixed, but hitherto without success. I found, however, the following diatoms in the very minute gathering which I received :—

Cymbella cuspidata.
Nitzchia amphioxys.
Gomphonema constrictum.
Synedra ulna.
Surirella minuta.
Navicula cuspidata.
,, sphæophora.
,, amphibæna.
Achnanthis exilis.

Whangarei, Auckland.

Samples of this fresh-water deposit have been placed in my hands, but I take a list of the species comprising it from the MSS. notes of Professor Hutton, made some years ago. Samples have found their way into the hands of English diatomists.

Pinnularia gibba.
,, nobilis.
Navicula pusilla.
,, westii.
,, cuspidata.
Stauroneis phœnicenteron.
Synedra radians.
Coccœoneis placentula.
,, ?
Eunotia (Himantidium) bidens.
Gomphonema constrictum.
Cymbella cuspidata.
Melosira arenaria.
,, ?
Epithemia rupestris.
,, hyndmanii.
, zebra.
longicornis.

Cabbage-tree Swamp, Auckland.

This fresh-water deposit has also been put into my hands, and samples have found their way to England, but, as before, I take my list of species from Professor Hutton's MSS. notes:—

Achnanthidium inflata.
Eunotia (Amphicampa) eruca.
„ (Himantidium) bidens.
„ „ arcus.
„ diodon.
Pinnularia major.
„ interrupta.
„ radiosa.
Epithemia turgida.

Art. XLIII.—*On the* Lichenographia *of New Zealand.*

By Charles Knight, F.R.C.S.

[*Read before the Wellington Philosophical Society, 28th February*, 1883.]

Plates XXXV.–XXXVIII.

In continuing my papers on the Lichenographia of New Zealand, I wish to make the following remarks:—

In respect of the *Arthoniæ*. The leading characters of this genus, as given by Leighton in 3rd. ed. of Lichen Flora, are:—"*Asci pyriform in excavations of the sub-gelatinous hymenium; paraphyses none.*" The term "excavations" is not a happy one, but let that pass. Nylander seems to avoid committing himself to an unqualified statement of character, and instead of "paraphyses none," limits himself merely to the terms "*paraphysibus discretis nullis.*" In reference to the above, I have already, in a paper on the lichens of New South Wales, called attention to the remark of Professor J. Müller, of Geneva (Flora, 11th April, 1879), where he states that paraphyses are always present in the *Arthoniæ*. This assertion of Müller needs qualification. In those *Arthoniæ* where the lamina sporigera is said to be grumose or homogeno-grumose, there exists in most cases no trace whatever of paraphyses or of stratification,—the structure is confused, cellular, or even granular. In others, where the lamina sporigera is said to be floccose, the structure is really clathrato-ramose, and is mostly condensed and rendered columnar in appearance by the pressure of the growing asci, as is seen in *A. globulosæformis*, Hepp, *A. lurida*, Ach., *A. kempelhuberi*, Mass., etc. Again in others distinct filaments can be traced, knit together in a more or less open network, as in *A. gregaria*, Ach., *A. swartziana*, Ach., *A. oleandri*, etc., and also as in most of the species of

Arthonia described in the present paper, with the exception of *A. aspera* (n. sp.), in which the lamina sporigera is more or less carbonized and degraded.

In respect of the *Pertusariæ* importance is always attached to the extraordinary thickness of the sporal envelope, which often consists of three or more laminæ; and this characteristic, when the paraphyses are implexo-ramose, is of the highest importance. Indeed, the presence of implexo-ramose paraphyses has induced Professor Müller to transfer several *Lecanoræ* to *Pertusaria*. In a paper on the lichens of New South Wales (Linn. Trans. Botany, second series, vol. 2) I called attention to Professor Müller's remarks (Flora, 1879, No. 39, p. 484) in which he advocates these transfers, and I noticed that, in my opinion, besides *L. parella* and *L. pallescens*, there are other species liable to similar removal; for instance, *L. verrucosa*, and *L. calcarea*. Hepp, together with Nylander and Th. Fries, has placed *Lecanora bryontha*, Ach., with the *Pertusariæ*, an arrangement amply supported by the great thickness of the parietes of the solitary spores and the implexo-ramose paraphyses. It may be added that the presence of intricate ramose paraphyses with thick double sporal envelopes renders it necessary that *Lecanora gemmifera*, Th. Fries, should also be transferred to *Pertusaria*. *P. fumosa* (n. sp.) of the present paper has a thin sporal envelope.

I have read with some interest in the Flora (1882, p. 458) Dr. Nylander's objections to break up a large genus of closely-allied species and dispose of them in several genera. We all agree with Ray,—"Methodum intelligo naturæ convenientem quæ nec alienas species conjungit, nec cognitas separat." But it seems to be contended by Dr. Nylander that cognate species, however numerous they may be, ought not to be separated into genera and that no limiting number of species can be assigned to a genus. Certainly there is no reason why we should fix upon an arbitrary limiting number, which it would be improper to exceed; although, on the other hand, it may be desirable that genera should not be overburdened with species. One of the objects of classification is, that the generic name, like an algebraic formula, should be the symbol of certain characteristics of all the species included in the genus and these are stored in our memory.

To take an instance. There are not much less than 500 species at present arranged under *Lecidea*, a genus which is limited by a small number of characters. Is it not a real disadvantage to the progress of a science that the generic name in this instance conveys to the mind so little of the nature and organization of any one of the 500 species. On the other hand, if we break up the *Lecideæ* into several genera and group the new genera in

natural sequence under one tribe or subtribe, the few characters which at present define the genus would be sufficient for the higher group, in accordance with the law enforced by Jussieu, that the larger the group the fewer the characters by which it is limited. What reasonable objection can be urged to the proposal. We should outrage no natural alliance of the species. While the advantage would consist in this, that the name of each lichen would carry with it not only the tribal characters but also its distinguishing generic characteristics, and would thus secure to the student one of the leading objects of a natural classification.

It is urged that to scatter cognate species amongst a number of genera would be an offence against the harmony that exists in nature; but if so, and we are to be governed by mere prudery, no division of species could be admitted, seeing that, as Ray asserted and Linnæus copied, "*Natura non facit saltus.*" Indeed, there is no scheme of classification which is not liable to the objection that between two closely-allied genera there will always be one or more species which can be placed in either of the two; and, as Lindley observes in "The Vegetable Kingdom,"—"it cannot be of any possible consequence whether an intermediate or frontier plant be assigned to one group or another and convenience alone should be considered in such a matter. * * * All the groups into which plants are thrown are, in one sense, artificial, inasmuch as Nature recognizes no such groups. Nevertheless, consisting in all cases of species very closely-allied in nature, they are in another sense natural. But as the classes, subclasses, alliances, natural orders and genera of botanists have no real existence in nature, it follows they have no fixed limit and consequently it is impossible to define them." That differences exist among the *Lecideæ* as now constituted sufficient for the purpose of arranging the species under several genera is certain from the success which appears to have attended the labours of Massolonga and others. Nylander himself has arranged them in sections. As to the questionable value of Massolonga's scheme, I do not at present wish to make any remarks, or to criticize Nylander's sectional arrangement.

1. *Bæomyces novæ-zealandiæ*, n. sp.

Thallus crustaceus tenuissimus sordide luteolus, madefactus albo-virescens, effusus pulverulens (microscopi area granula gonima obsita). Apothecia discoidea peltata, in centro peranguste adnata (diam. circa 2 mm.) madefacta albo-incarnata et convexa, margine obsoleto, excipulo proprio incolorato arachnoideo-filamentoso (filis diam. 0·001 mm.), paraphysibus tenuissimis densatis paucis apice laxis nonnihil ramosis. Sporæ in ascis cylindraceis angustissimis confertissimis uniseriales oblongo-subfusiformes incolores simplices, guttam unam magnam (evanescentem glycerinâ) centralem continentes, longit. 0·017 mm., crassit. 0·006 mm.

C. Knight, del.

LICHENES.

Obs.—*B. roseus* (Sch. No. 31) thallo granuloso, sporis fusiformibus leviter curvatis (long. 0·015, crass. 0·0025 mm.) luteolis. *B. byssoides* (Schær. No. 32) hymenio fusco, sporis ellipsoideis long. 0·01 mm., crass. 0·004 mm.

2. *Thelotrema circumscriptum*, n. sp.

Thallus ex ochraceo pallido-fuscus lævis subnitiusculus tenuis continuus linea fusca determinatus, verrucis apotheciorum hemisphæricis (diam. 0·5 ad 1 mm.) prominulis, ostiolo simplici. Apothecia immersa excipulo proprio laterali dilute fusco instructa, matrice enata, madefacto epithecio in sectione multo dilato, paraphysibus distinctis apice dilute coloratis. Sporæ subclaviformes interdum oblongæ hyalinæ 6–12-septatæ, long. 0·02 ad 0·035 mm., crassit. 0·005 mm.

Ad cortices arborum.

3. *Thelotrema farinaceum*, n. sp.

Thallus albus cartilagineus nitidus continuus, verrucis apotheciorum globosis confertis. Apothecia primum clausa tandem late aperta, disco dilute colorato albo-pruinoso, margine albo elevato farinaceo, paraphysibus subtilissimis subramosis. Sporæ in ascis crebris monosporis oblongo-clavatæ circiter 14-septatæ, longit. 0·14 mm., crassit. 0·04 mm.

Ad arborum cortices.

4. *Pertusaria leucodes*, n. sp.

Thallus albus passim rimosus, verrucis apotheciorum convexis v. hemisphæricis concoloribus, ostiolo primitus minuto mox in pseudo-discum nunc planum nunc urceolatum (interdum cavatum) confluentibus. Apothecia 1–3 in quavis verruca, exciplo proprio nullo, hymenio thallo enato, paraphysibus adglutinatis clathratim-ramosis. Sporæ 2, 4, 8næ, in iisdem apotheciis, ellipsoideæ simplices, pluries limbatæ, longit. 0·05 mm., crassit. 0·02 mm.

Ad arborum cortices.

5. *Pertusaria fumosa*, n. sp.

Thallus fumoso-nigricans intus albus tuberculosus, tuberculis apotheciorum parvis globosis albescentibus mox hiantibus, epithecium urceolatum nigrescens denudantibus, margine elevato nonnihil subtumido irregulari, exciplo proprio nullo, hymenio strato gonimico oriundo, paraphysibus adglutinatis obscure ramosis. Sporæ in ascis clavatis ovoideæ simplices angusté limbatæ luteolæ, longit. 0·025 mm., crassit. 0·012.

Ad arborum cortices.

6. *Phlyctis stromaphora*, n. sp.

Thallus crassus albidus granulosus areolatus, areolis nonnihil conglobatis. Apothecia in stromatibus thallinis creberrimis rotundato-difformibus v. convexo-prominentibus v. planis inæqualibus immersa, plura in singulis

stromatibus, punctis minutis indicata inde plerumque pyreno-carpoidea, passim epitheciis tandem evolutis fuscis concavis sæpe confluentibus et tum varie oblongis, margine thallino elevato cinctis, madefactis thallum æquantibus ; hymenium thalli strato crasso impositum, paraphysibus capillaribus non discretis apice fuscis non dilatis. Sporæ ellipsoideæ v. fusiformes nonnunquam cuneiformes 7–8-septatæ tandem flavescentes, longit. 0·057 mm., crassit. 0·013 mm.

Ad arborum cortices.

7. *Phlyctis cyrtospora*, n. sp.

Thallus cinereo-albidus tenuis lævis continuus, arefactus minutissime areolatus. Apothecia innata rotundato-difformia parva sparsa (solitaria v. aggregata), margine thallino crasso plano elevato, excipulo proprio nullo, paraphysibus bene discretis. Sporæ oblongo-fusiformes nonnunquam cuneiformes 7-septatæ luteolæ demum fuscentes curvatæ, longit. 0·085 mm., crassit. 0·018 mm.

Ad arborum cortices.

Obs.—*Phlyctis oleosa*, Stirt., "thallus areolato-diffractus, areolis concavis, sporæ incolores in thecis incrassatis una cum guttulis flavidis oleosis inclusæ" (*Stirton*).

8. *Bacidia minutissima*, n. sp.

Thallus tenuis ex olivaceo fuscus continuus indeterminatus. Apothecia minutissima (diam. 0·2 mm.) innata convexa nigro-fusca nonnihil e thallo velata immarginata, hymenio (in sectione subtilissima) dilute fusco, strato subhymeniale fusco, excipulo proprio dilute fusco—texturâ radiatim dispositâ—paraphysibus adglutinatis gracilibus apice dilutis fuscis. Sporæ in ascis clavatis bacillares spiraliter curvatæ nonnihil rectæ circiter 9-septatæ incolores, longit. 0·043 mm., crassit. 0·003 mm.

Ad arborum cortices.

9. *Lecidea* (*Catillaria*) *clathrata*, n. sp.

Thallus cinereus v. dilutæ cinereo-viridescens subgranulosus continuus linea atra limitatus. Apothecia atro-fusca superficialia (diam. circ. 3 mm.) nonnullo margine thallode in parte instructa, disco pruinoso, margine proprio atro-fusco prominente nonnihil nitido, hypothecio incolori excipuli linea atra imposito, excipulo dilute ochraceo-fusco in summo atro et linea atra omnino circumscripto, paraphysibus adglutinatis subtilissimis (crassit. 0·001 mm.) clathrato-ramosis. Sporæ in ascis oblongis magnæ ovatæ plerumque incurviusculæ uniseptatæ (epispora crass. 0·005 mm.) incolores, longit. 0·06 mm., crassit. 0·03 mm.

Ad arborum cortices.

Obs.—Inter *L. marginiflexam* atque *L. clathratam* præcipua differentia in sporis illius oblongis et ascis monosporis, hujus sporis ovatis et 8nis est

posita. *L. grossa*, excipulo omnino carbonizato. *L. versicolor, v. tuberculosa*, et *L. taitensis* excipuli structura radiante. *L. grossa, versicolor, taitensis*, sporis multo minoribus quam in *L. clathrata.*

10. *Lecidea cinnabaroides*, n. sp.

Thallus sordide testaceus effusus nonnihil leprosus tenuissimus. Apothecia rubra sparsa, margine concolore crassiusculo prominente, excipulo e guttis oleaceis hyalinis alius minutis alius sat grandibus formato, textura non radiatim disposita, a lateribus et basi per lineam tenuem aurantiacam contento, paraphysibus distinctis apice coloratis ovato-dilatis. Sporæ in ascis clavatis simplices luteolæ v. incolores ellipsoideæ, longit. 0·015 mm., crassit. 0·007 mm.

Ad arborum cortices.

Obs.—L. cinnabaroides, Nyl., *in litt.*

11. *Arthonia* (*Coniangium*) *stictaria*, Nyl.

Thallus nullus. Apothecia atra innata rotundata ambitu applanata in centro convexa, hymenio tenui (crass. 0·035 mm.) pseudo-excipulo e matrice vitiata constante, lamina sporigera laxissime clathrata, hypothecio tenui grumoso in marginem se explicato. Sporæ in ascis pyriformibus minutæ obovatæ incolores 1-septatæ, cellula superiore ampliore, long. 0·009 mm., crass. 0·0035 mm.

Ad Stictam auratam parasitica.

12. *Arthonia* (*Coniangium*) *conspicua*, Nyl.

Thallus sordide albus tenuissimus (v. nullus) continuus. Apothecia hypoplæodes sparsa rubricoso-fusca nuda rotundata v. difformia aspera, madefacta convexa (diam. circiter 1 mm.), intus luteo-fusca, lamina sporigera perfecto clathrato-ramosa. Sporæ in ascis globosis oblongo-ovoideæ 1-septatæ (cellula superiore vix ampliore) dilute luteo-fuscæ tandem fuscæ, emortuæ atro-fuscæ, longit. 0·025 ad 0·032 mm., crassit. 0·01 ad 0·012 mm.

Ad arborum cortices.

Obs.—Ab *A. lurida*, Ach., et *A. vinosa*, Leight., differt sporis duplo majoribus. *Syn. Myriangium inconspicuum*, Bab. ("Flora New Zealand," p. 310.)

13. *Arthonia aspera*, n. sp.

Thallus albidus v. albido-cinerascens, plagulas parvas formans, tenuissimus lævis continuus. Apothecia hypoplæodes adnata aspera atra rotundato-difformia parva (latit. circiter 0·5 mm.) intus fusca excipulo destituta hymenio nullo, lamina sporigera floccosa plus minus carbonizata. Sporæ in ascis pyriformibus cuneato-oblongæ 6-loculares, loculo supremo vix ampliore, fuscæ emortuæ atro-fuscæ, long. ·017, crassit. ·006 mm.

Ad cortices.

14. *Arthonia lecideoides* n. sp.

Thallus uniformis lævis v. pulverulento-furfuraceus (passim byssoideo-furfuraceus) olivaceus, gonidiis crebris. Apothecia pseudo-lecidina hypoplæodes rotundato-difformia plana non-nihil subconvexa atra adnata immarginata (diam. circiter 1 mm.), hymenio fusco, lamina sporigera floccosa (vere subtilissime clathratim ramosa), basi laminæ sporigeræ et matrice plus minus carbonizatis, crassis. Asci pyriformes inter laminas sporigeras condensatas oriundi. Sporæ nymphæformes ex hyalino fuscidulæ, emortuæ fuscæ, 5-cellulæ, cellula extrema ampliore, longit. ·023, crassit. ·008 mm.

Ad cortices.

15. *Arthonia lirellæformis*, n. sp.

Thallus e lilacino cinerascens tenuis lævis continuus per lineam fuscam limitatus. Apothecia hypoplæodes (matrice immutata) fusca lirellæformia oblonga v. elongata simplicia v. ramosa plerumque flexuosa undique attenuata innata ambitu cinereo-pulverulenta, hymenii lateri carbonizato, lamina sporigera clathrata et tanquam ab ascis compressa epithecio atro-fusco. Sporæ in ascis pyriformibus obtuse cuneato-oblongæ tandem fuscidulæ 4-septatæ, cellula suprema ampliore, longit. 0·02 mm., crassit. 0·008 mm.

Ad cortices arborum.

16. *Arthonia pellucida*, n. sp.

Thallus e cinereo albus tenuissimus lævis continuus. Apothecia hypoplæodes (matrice immutata) atro-fusca depressiuscula lobato-difformia sæpe inter se juncta, ambitu a thallo plus minus velata intus pellucida, pseudo-excipulo omnino destituta, lamina sporigera laxissime clathrata. Sporæ in ascis globosis cuneato-oblongæ hyalinæ tandem fuscidulæ 5-septatæ, cellula superiore ampliore ceteris plerumque longitudionalibus divisis, longit. 0·02 mm., crassit. 0·008 mm.

Ad arborum cortices.

Obs.—Affinis est *A. lirellæformi* et vix differt nisi pseudo-excipulo omnino egente et sporæ cellulis longitudionalibus divisis ; fortasse tamen haud species est distincta.

17. *Arthonia* (*Lecanactis*) *tenuissima.*

Thallus nullus v. macula minuta albida indicatus. Apothecia hypoplæodes (matrice immutata) atra maculæformia intus mox fusca v. atra, hymenio tenui (crass. 0·06 mm.), ambitu evanescente, lamina sporigera laxissime clathrata. Asci fusiformi-ellipsoidei creberrimi (long. 0·046 mm.) Sporæ naviculares hyalinæ mox fuscescentes emortuæ atro-fuscæ 5-septatæ, cellulis mediis paulo amplioribus, longit. 0·014 mm., crassit. 0·005 mm.

Ad arborum cortices.

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18. *Arthonia* (*Lecanactis*) *verruculosa*, n. sp.

Thallus sordide cinereus plus minus rimosus in agellos a hypothallo (e matrice carbonizata constante) denudato metatus. Apothecia hypoplæodes fusco-atra rotundato-difformia plana singulis thalli areolis verruculisve innata, verruculis vix elevatis, hymenio tenui dilute fusco, pseudo-excipulo e matrice carbonizata constante, lamina sporigera obscura clathratim ramosa. Sporæ in ascis clavatis crebris emortuis fuscis cymbiformes 3-septatæ hyalinæ, long. 0·014 mm., crassit. 0·005 mm.

Ad arborum cortices.

19. *Arthonia* (*Arthothelium*) *suffusa*, n. sp.

Thallus squamulis albidis conglutinatis minutissimis constans, subtiliter areolatus, in agellos a hypothallo nigro denudato metatus. Apothecia hypoplæodes minuta crebra nigricantia prominula rotundata nonnihil e thallo suffusa (latit. circiter ·5 mm. v. minora) a thallo interdum coronata, excipulo omnino destituta, lamina sporigera obscuré clathrata. Sporæ in ascis ellipsoideo-oblongis ovatæ v. oblongæ demum fuscæ, seriebus 7–9 transversim loculosæ, loculis plerumque 3 in quavis seriebus, longit. ·033 mm., crassit. ·028 mm. Matrix non mutatur.

Obs.—Prope *Arthoniam abnormem*, Ach., et *A. anastomosantem;* differt vero sporis majoribus.

Ad cortices.

20. *Arthonia* (*Arthothelium*) *spadicea*, n. sp.

Thallus cinereo-albus uniformis tenuis lævis linea nigra limitatus. Apothecia hypoplæodes spadicea v. ochreo-fusca innata plana rotundato-difformia v. irregulariter elongata (latit. circiter 1 mm.) a thallo non coronata, excipulo omnino destituta, hypothecio nullo, lamina sporigera floccosa—obscuré clathratim ramosa. Asci pauci ventricoso-globosi (latit. 0·5 mm.) Sporæ ovatæ v. oblongæ fuscæ, seriebus circa 10 transversim loculosæ, plerumque 5 in quavis seriebus, longit. ·04, crassit. ·018 mm. Matrix non mutatur.

Ad cortices.

Obs.—Prope *Arthoniam xanthocarpam*, Nyl.; sed differt sporis coloratis minoribus loculisque majoribus, et thallo continuo.

21. *Stigmatidium confluens*, n. sp.

Thallus ex albo cinereus cartilagineus continuus, protuberantibus thallinis apotheciorum vix ullis subconvexis confluentibus, ostiola minutissima. Apothecia orbicularia immersa excipulo proprio crasso dilute luteo-colorato integro instructa, hymenio madefacto latit. circ. 0·3 mm., paraphysibus distinctis apice non coloratis. Sporæ in ascis cylindraceis oblongæ 4-cellulæ hyalinæ nonnihil luteolæ, longit. 0·02 mm., crassit. 0·011 mm.

Ad arborum cortices.

22. *Fissurina monospora*, n. sp.

Thallus cinereo-albus rugosus, rugis apothecia rimiformia includentibus. Apothecia immersa conferta flexuosa brevia intus incoloria, marginibus thallinis conniventibus crassis tumidis elevatis, excipulo proprio nullo, paraphysibus adglutinatis gracilibus cellularibus (cellulis longit. 0·01 mm.) Asci perpauci monospori, parietibus tenuissimis. Sporæ ovato-ellipsoideæ lutea minute murali-divisæ, longit. 0·18 mm., crassit. 0·08 mm.

Ad arborum cortices.

23. *Fissurina cyrtospora*, n. sp.

Thallus e luteolo albidus tenuis lævis continuus, in gonidiis veris glaucescentibus consistens. Apothecia linearia (latit. 0·3 mm.) elongata furcato-divisa flexuosa, marginibus thallinis concoloribus conniventibus tumidis, excipulo proprio nullo, hymenio matrice imposito, lamina sporigera granulosa (paraphysibus nullis !). Sporæ in ascis ventrico-clavatis oblongæ plus minus curvatæ simplices, longit. 0·026 mm., crassit. 0·007 mm.

Ad arborum cortices.

24. *Ascidium fusiforme*, n. sp.

Thallus e viridi cinereus tenuis leprosus, verrucis apotheciorum convexis v. subhemisphæricis pallido-fuscis circa ostiola minutissima pallidis vix prominulis. Apothecia excipulo proprio globoso integro pallido-luteo-fusco instructa, paraphysibus subtiliter capillaribus bene distinctis. Sporæ in ascis cylindraceis 4–8næ acute fusiformes 7–9-septatæ hyalinæ, longit. 0·09 mm., crassit. 0·02 mm.

Ad cortices arborum.

Obs.—Affine *V. desquamescenti*, Fée (Leight. Lich. Ceyl.), a qua differt præcipue sporis prope duplo majoribus et verrucis circiter triplo majoribus. Excipulum (= perithecium) *V. desquamescentis* integrum quod ad exemplum Thwaitsii in meo herbario attinet,—"Perithecium *dimidiatum*." (Leight. Trans. Linn. Soc., vol. xxvii., p. 183.)

25. *Ascidium attenuatum*, n. sp.

Thallus albescens tenuis continuus, verrucis apotheciorum convexo-mastoideis concoloribus, ostiolo latiore. Apothecia partim in matrice immersa, excipulo depresso-globoso tenui pallido-fusco, epithecio colorato madefacto in pseudo-discum confluente, paraphysibus subtiliter capillaribus bene discretis. Sporæ in ascis 1–3 sporis fusiformes utrimque attenuatæ 25–30-septatæ primum hyalinæ mox fuscæ tandem atro-fuscæ, longit. 0·113 mm., crassit. 0·021 mm.

Ad cortices.

Obs.—Affine est *Ascidio domingensi*, Fée.

26. *Ascidium manosporum*, n. sp.

Thallus albus v. sordide albus effusus tenuis, verrucis apotheciorum convexis concoloribus v. pallido-fuscis, ostiola minutissima prominula. Apothecia excipulo proprio globoso integro tenui fusco instructa, hymenio tandem atro-fusco (in lamina subtilissima fusco); paraphysibus capillaribus bene distinctis. Sporæ in ascis monosporis fusiformes v. elongato-cylindraceæ tandem fuscæ murali-divisæ—seriebus loculorum transversis 20–30 in quavis serie 2–8 loculis in medio et 3–1 versus apicem utrumque, longit. 0·1 ad 0·13 mm., crassit 0·02 ad 0·03 mm.

Ad cortices.

Obs.—Var. *a*. Excipulum et hymenium pallida.

27. *Verrucaria* (*Leptorhaphis*) *macrocyrtospora*, n. sp.

Thallus obscurus macula pallido-flavescente indicatus (vix matricem colorans) v. nullus, verruculis apotheciorum minutis (basi latit. circa 0·8 mm.) convexis. Apothecia orbicularia primitus immersa, excipulo proprio atro integro mox supra denudato—tum margine thallode tumidulo—hymenio dilute fusco, paraphysibus capillaribus perplexis. Sporæ in ascis cylindraceis (long. 1·3 mm.) aciculares utrimque acutatæ hyalinæ in arcum constanter plus minus curvatæ 13-septatæ v. ultra, longit. 0·11, crass. 0·003 mm.

Ad arborum cortices.

Obs.—*Verr. beloniza*, Stirt. Sporæ rectæ, septa non visa.

28. *Verrucaria submargacea*, n. sp.

Thallus olivaceo-fuliginosus tenuissimus contiguus lævigatus determinatus, gonidiis veris ubique confertis. Apothecia nigra minuta (diam. 0·3 mm.) hemisphærica protuberantia a thallo leviter obtecta, excipulo dimidiato atro apice poro minutissimo instructo, paraphysibus nullis. Sporæ in ascis clavatis simplices dacryoideæ incolores, longit. 0·023, crassit. 0·01 mm.

Ad saxa.

Obs.—Persimilis *V. æthiobolæ* præcipue sporis dacryoideis sed differens sporis majoribus.

29. *Verrucaria* (*Polyblastia*) *trachyspora*, n. sp.

Thallus fuscus tenuissimus continuus. Apothecia hemisphærica minuta dimidiata atra ad basim immersa, ostiolo depresso minutissimo madefacto prominente ambitu albescente, paraphysibus distinctis ramosis. Sporæ in ascis claviformibus nonnullis cylindraceis ovatæ murali- v. ruderiformi-divisæ, cellulis subpaucis irregularibus, hyalinæ incolores interdum luteolæ, longit. 0·018, crassit. 0·01 mm.

Ad lapides.

Obs.—*P. tichospora*, Knight (Trans. Linn. Soc., vol. ii, p. 37). Thallus cinerascens, sporæ minores.

30. *Verrucaria* (*Pyrenula*) *arthoniza*, n. sp.

Thallus ochraceus v. pallido-ochraceus tenuis areolatus, verrucis apotheciorum minutis (basi latit. circ. 0·5 mm.) hemisphæricis v. convexis. Apothecia orbicularia primitus immersa, excipulo proprio atro crasso integro mox supra denudato—tum arthonoidea et margine thallode tumidulo—paraphysibus distinctis. Sporæ in ascis cylindraceis, ellipsoideæ normaliter loculos 4 transversos lentiformes offerentes, hyalinæ tandem fuscescentes, longit. 0·015, crassit. 0·006 mm.

Ad arborum cortices.

31. *Verrucaria* (*Acrocordia*) *subatomaria*, n. sp.

Thallus obscurus v. nullus. Matrix non mutatur. Apothecia minutissima orbicularia (diam. 0·2 mm.) in matrice subimmersa, excipulo proprio integro atro-fusco, ostiolo minuto nonnihil hiante, hymenio pallido-fusco paraphysibus reticulato-capillaribus. Sporæ in ascis elongato-pyriformibus oblongæ 1-septatæ incolores hyalinæ, longit. 0·017, crassit. 0·007 mm.

Ad cortices.

Obs.—*V. subatomaria*, Nyl., *in litt.* Dr. Nylander's name is adopted. It will be seen, however, that the *entire* proper excipulum and hyaline colourless spores separate this species so widely from *V. atomaria*, DC., as to render the prefix of "*sub*" somewhat misleading.

32. *Verrucaria* (*Segestria*) *metabletica*, n. sp.

Thallus sordide cinereus tenuis continuus (matrice reticulato-rugosa) granulas gonimas virides in nodulis magnis continens. Apothecia madefacta adnata atra minuta (diam. 0·2 mm.) hemisphærica, excipulo dimidiato, ostiolo pallido minutissimo v. nullo, paraphysibus distinctis. Sporæ in ascis cylindraceis fusiformes incolores 3–7-septatæ, longit. 0·02, crassit. 0·005 mm.

Ad arborum cortices.

Obs.—Var. *a.* Thallus albescens, sporæ 7-cellulæ, cellulis medio majoribus.

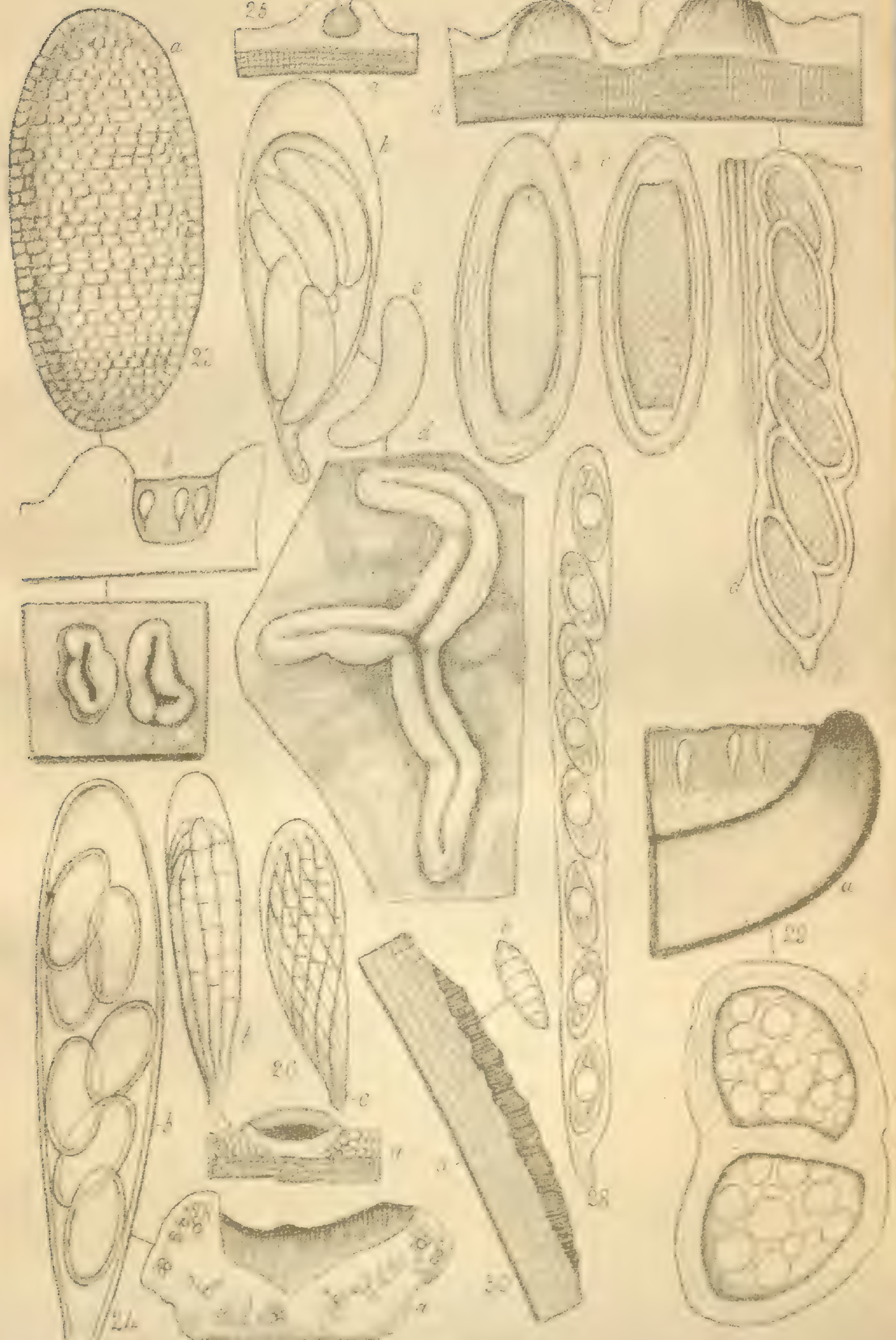
33. *Verrucaria* (*Thelidium*) *suffusa*, n. sp.

Thallus cinereus tenuis effusus a linea fusca limitatus. Apothecia minuta (diam. 0·3 mm.) hemisphærica thallo leviter obtecta, excipulo atro crasso dimidiato, ostiolo suffuso tandem prominulo nonnihil ambitu dealbato, hymenio matrice imposito, paraphysibus adglutinatis rectis oleoso-grumosis. Sporæ in ascis elongato-clavatis oblongæ 3-septatæ incolores, longit. 0·028, crassit 0·008 mm.

Ad arborum cortices.

34. *Verrucaria* (*Thelidium*) *calcarea*, n. sp.

Thallus atro-fuscus tenuissimus irregulariter effusus v. nullus. Apothecia minuta (diam. 0·25 mm.) innato-sessilia hemisphærica v. convexa,



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ostiolo minuto simplici, excipulo proprio dimidiato atro, paraphysibus nullis(!). Sporæ in ascis clavatis ovatæ equaliter 2-cellulæ hyalinæ, longit. 0·018, crassit 0·009 mm.

Ad calcem in regionibus calcareis.

Obs.—*V. olivacea*, Fries. Sporæ diam. 3–4plo longiores.

V. pyrenophora, Ach. Sporæ multum majores 3-septatæ.

DESCRIPTION OF PLATES XXXV.-XXXVIII.

OBS.—Spores and asci × 930, unless otherwise noted. Sections of apothecia and drawings of thallus × 40, unless otherwise noted.

PLATE XXXV.

Fig. 1. *Arthonia lecideoides*; (*a*) section of apothecium, (*b*) spores in ascus.

2. *Arthonia lirellæformis*; (*a*) thallus showing apothecia, (*b*) sect. of apothecium, (*c*) spores in ascus.

3. *Arthonia spadicea*; (*a*) section of apothecium, (*b*) spores in ascus.

4. *Arthonia suffusa*; (*a*) spores in ascus, (*b*) section of apothecium, (*c*) showing the texture of lamina sporigera.

4*a*. *Arthonia stictaria*; spores in ascus.

4*b*. *Arthonia pellucida*; single spore.

5. *Arthonia conspicua*; spores in ascus.

6. *Arthonia verruculosa*; (*a*) thallus showing apothecia, (*b*) section of apothecium, (*c*) two spores.

7. *Arthonia aspera*; (*a*) section of apothecium, (*b*) two spores.

PLATE XXXVI.

Fig. 8. *Verrucaria macrocyrtospora*; (*a*) spore, (*b*) ascus, (*c*) section of apothecium.

9. *Verrucaria trachyspora*; spores in ascus.

10. *Verrucaria arthoniza*; (*a*) spores in ascus, (*b*) section of apothecium × 80.

11. *Verrucaria calcarea*; spores in ascus.

12. *Verrucaria suffusa*; (*a*) section of apothecium, (*b*) spores in ascus.

13. *Verrucaria submargacea*; (*a*) spores in ascus, (*b*) single spore, frequent variety.

14. *Verrucaria metabolica*; (*a*) portion of thallus showing two apothecia, (*b*, *c*, *d*) three asci showing varieties of spores.

15. *Verrucaria subatomaria*; (*a*) section of apothecium, (*b*) spores in ascus.

16. *Phlyctis stromaphora*; (*a*) spore, (*b*) section of apothecium.

PLATE XXXVII.

Fig. 16*a*. *Thelotrema farinaceum*; (*a*) spore, (*b*) section of apothecium.

17. *Phlyctis cyrtospora*; (*a*) section of apothecium, (*b*) spore, (*c*) spores in ascus.

18. *Ascidium manosporum*; (*a*) spore × 900, (*b*) spore × 540, (*c*, *d*) two spores discovered in same apothecium × 330, (*e*) section of apothecium.

19. *Stigmatidium confluens*; (*a*) thallus showing apothecia, (*b*) section of apothecium, (*c*) single spore.

19*a*. *Ascidium attenuatum*; spore in ascus.

20. *Ascidium fusiforme*: (*a*) section of apothecium, (*b*) spore.

21. *Lecidea cinnabaroides*; spores in ascus.

22. " " section of apothecium.

PLATE XXXVIII.

Fig. 23. *Fissurina monosporum* ; (*a*) spore, (*b*) section of apothecium.

24. *Pertusaria fumosa* ; (*a*) section of apothecium, (*b*) spores in ascus.

25. *Fissurina cyrtospora* ; (*a*) section of apothecium, (*b*) spores in ascus, (*c*) spore, (*d*) thallus showing apothecium.

26. *Bacidia minutissima* ; (*a*) section of apothecium, (*b*) straight spores in ascus, (*c*) arcuate spores in ascus.

27. *Pertusaria leucodes* ; (*a*) section of apothecium, (*b* and *c*) two spores × 900. (*d*) spores in ascus × 330.

28. *Bæomyces novæ-zealandiæ* ; spores in ascus.

29. *Lecidea clathrata* ; (*a*) section of apothecium, (*b*) spore.

30. *Arthonia tenuissima* ; (*a*) section of apothecium, (*b*) spore.

ART. XLIV.—*Description of two new Species of* Carex. By D. PETRIE, M.A.

[*Read before the Otago Institute, 30th January, 1883.*]

Carex littoralis, n. sp.

A SMOOTH, tufted species, 1 to 2 feet high. Leaves nearly as long as the culms, sheathing towards the base, very narrow, striate, plano-convex in section, almost smooth, pale green.

Culms round, smooth, with long leaf-like bracts shortly sheathing at the base.

Spikelets 4 or 5, uppermost slender, longer, male ; lower female with a few male flowers below, stout, ¼ to ½ inch long, sessile or very shortly peduncled, the peduncle being enclosed by the sheathing base of the bract.

Glumes ovate, membranous, dark brown, with lighter three-ribbed mid-rib, produced into a short tapering awn.

Utricle ovate, turgid, two-ribbed, reddish-brown ; beak short, bifid.

Arms of style 3 short.

Hab. Paterson's Inlet, Stewart Island ; Otago Harbour. It appears to be confined to tidal swamps, and low-lying ground about the level of high-water mark. I have never seen it inland or in any other situations than such as are indicated above. Mr. Cheeseman, of the Auckland Museum, informs me that he has this plant from various parts of New Zealand, so that it evidently has a wide distribution.

Carex cheesemanii, n. sp.

A very slender, densely tufted, pale, rather harsh species.

Culms 16 inches, or less, rounded, very slender, drooping, elongating greatly during ripening.

Leaves very numerous, shorter than the culms, very narrow, flattened or plano-convex, scabrid, broad at the bases which sheath the lower parts of the culm.

Spikelets usually 6–8, lower distant on slender peduncles, upper approximate and nearly sessile; all short and pale-brown; uppermost male, others male at the base only; bracts very long and slender.

Glumes shorter than the utricles, broad, very membranous, pale-brown at sides, white near the three-nerved midrib which is continued beyond the bifid apex into a long usually scabrid awn.

Utricle turgid, plano-convex, pale-brown, beak short, bifid, toothed or plain.

Arms of the style 3.

Hab. Maniototo Plain 1,000–2,000 feet; Nevis Valley 1,500 feet.

Named in honour of T. F. Cheeseman, Esq., Curator of the Auckland Museum, who has done much to settle the New Zealand species of this genus.

Art. XLV.—*Description of a Variety of* Celmisia sessiliflora, *Hook. f.* By D. Petrie, M.A.

[Read before the Otago Institute, 30th January, 1883.]

Celmisia sessiliflora var. *minor.*

Much smaller in all its parts than the typical form of the species. Stems with leaves on about as stout as a goose quill, longer and much more branched. Leaves $\frac{1}{6}$ of an inch long or less, $\frac{1}{30}$ wide; sheaths longer and broader than the leaves, and much more villous than the type, especially at the tops of the sheaths. Achene relatively very short, about $\frac{1}{3}$ the length of the pappus.

This well-marked variety differs from the type of the species most conspicuously in the greatly smaller size of all its parts, and in the greater length and subdivision of its branches. Though separated from the specific type by a wide interval, the differences are not of sufficient variety to justify giving it specific rank. If, however, it should be found in other distant localities, I should have no doubt about regarding it as a distinct species. I have never gathered or seen any forms sensibly intermediate between this variety and the common form of the species. The genus is one that abounds in variable species, and the systematic working out of the varieties is much needed.

Hab. Swampy ground on the summit of Maungatua, Taieri: 2,900 feet.

Art. XLVI.—*Description of a new Species of* Senecio. By T. Kirk, F.L.S.

[Read before the Wellington Philosophical Society, 28th February, 1883.]

Senecio muelleri.

A large shrub or small tree 10–18 feet high, with spreading branches. Leaves 3″–7″ long, $1\frac{1}{4}$″–$2\frac{1}{2}$″ wide, crowded near the ends of the branches,

broadly lanceolate-acuminate, or ovate-acuminate, narrowed into a broad base, sessile, quite entire, densely clothed with white tomentum beneath. Flowers in erect terminal panicles sparingly leafy, 4″–8″ long; branches and involucre glandular or glandular pubescent: heads on short pedicels, involucral leaves in one series: ray-florets 12–14, narrow, contorted: disc florets about 20, perfect, regular, anthers with short tails. Achenes grooved, pappus white, scabrid.

Hab. Herekopere Island, *T. Kirk;* South Cape Island. Not observed on Stewart Island.

The main stem of this handsome species is often from 8″ to 12″ in diameter, branches distant, usually wide spreading and destitute of leaves below. In all stages they are thickly marked with the scars of fallen leaves. In the recent state the foliage is glossy and coriaceous, but these characters disappear in drying. After a continuance of rainy weather the tomentum becomes somewhat loose and gives a rugose appearance to the lower surface of the leaves. The bracts are always membranous, and those at the base of the panicles, which equal the ordinary leaves in size, are more or less recurved. Most frequently the panicle is simple, but occasionally its lower branches are compound; after flowering, the main axis becomes elongated and the panicle loses much of its original compactness. The panicle is always glandular and more or less viscid.

This fine plant approaches *S. huntii* of the Chatham Islands in habit, cicatricose branches, foliage and leafy inflorescence: but the structure of the flower allies it to *S. sciadophilus* and *S. perdicioides*, although its rays are much longer and the heads much larger. The narrow contorted yellow rays are widely different from the broad compact white rays of *S. huntii*: in this respect the latter resembles *S. glastifolius* and *S. hectori*.

Mr. Charles Traill of Stewart Island received living plants from the natives several years ago and has had them under cultivation, but they have not yet flowered. I collected the plant on sea-cliffs on Herekopere Island and was informed by an intelligent half-caste that he had collected it on South Cape Island. It does not appear to be known elsewhere, so that it further resembles *S. huntii* of Pitt Island in being restricted to a very limited area.

New Zealand botanists are specially indebted to Baron von Müeller for his excellent account of the vegetation of the Chatham Islands, so that I have great pleasure in connecting his name with so striking a plant.

III.—GEOLOGY.

Art. XLVII.—*Notes on the Mineralogy of New Zealand.*

By S. Herbert Cox, F.C.S., F.G.S., Assistant Geologist & Inspector of Mines.

[*Read before the Wellington Philosophical Society, 21st October*, 1882.]

The following paper, which is in continuation of the one published in last year's volume* of the "Transactions of the New Zealand Institute," will be devoted to the non-metallic minerals.

Non–Metallic Minerals.—Class I.

Water.

Water, H.—As a simple mineral this substance needs no comment, but, as pointed out by Dr. Hector (Handbook of New Zealand for Melbourne Exhibition, 1880, p. 102), New Zealand is singularly rich in springs of water that hold mineral salts in solution, and some of these are already noted for their valuable medicinal properties.

Both hot and cold springs are found, the former being, with few exceptions, confined to the districts of the North Island where volcanic forces have been active during the latest tertiary period, and are not yet altogether dormant. A few thermal springs are found to escape from the upper mesozoic rocks in localities where the source of heat can only be attributed to chemical decomposition of bituminous matters and sulphides; and, in a few instances, warm waters spring from palæozoic rock-formations in the South Island. The cold mineral springs have a wider distribution, but have only, as yet, been examined from comparatively few localities. The mineral waters of New Zealand may be classified, from the analyses that have been made in the Colonial Laboratory, into the following groups:—

Saline.—Containing chiefly chloride of sodium.

Alkaline.—Containing carbonates and bicarbonates of soda and potash.

Alkaline siliceous.—Waters containing much silicic acid, but changing rapidly on exposure to the atmosphere and becoming alkaline.

Hepatic or sulphurous.—Waters, the prominent character of which is the presence of sulphuretted hydrogen and sulphurous acid.

Acidic.—Waters in which there is an excess of mineral acids, such as hydrochloric and sulphuric acid.

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* Trans. N.Z. Inst., vol. xiv., p. 418.

The following is a list of the best-known mineral springs, full details concerning which are to be found in the official Laboratory Reports, Trans. N.Z. Inst., and other similar publications :—

No.	Name and District.	Temp. Fahr.	Solid Grains per pint.	Chemical Character.
		Deg.		
1	Ohaeawai, Auckland ..	60-116	16·8	Acid, Aluminous.
2	Waiwera ,, ..	110	17·7	Alkaline, Saline.
3	Puriri ,, ..	60	67·1	Alkaline, Carbonates.
4	White Island Lake, Bay of Plenty	97-212	1850·8	Strongly Acidic.
5	White Island Springs, Bay of Plenty	210	207·7	Strongly Acidic.
6	Pink Terrace Geyser, Rotomahana	208	19·3	Sulphurous.
7	White Terrace Geyser, Rotomahana	210	18·0	Alkaline.
8	Turikore, Whakarewarewa	96-120	10·9	Sulphurous.
9	Te Koutu Spring, Rotorua	90-180	9·1	Alkaline.
10	Koreteoteo ,,	214	13·0	Alkaline Caustic.
11	Kuirua ,,	136-156	9·9	Alkaline.
12	Manupirua, Rotoiti ..	107	4·1	Sulphurous.
13	Cameron's Bath ,, ..	109-115	14·3	Acid.
14	Ariki-kapakapa ,, ..	160	6·6	Acid.
15	Perekari ,, ..	130-150	7·0	Acid.
16	Ti Kute ,, ..	100-212	6·1	Sulphurous.
17	Te Mimi ,, ..	90-112	3·8	Acid.
18	Te Kauwhanga ,, ..	80-100	8·0	Acid.
19	Painkiller Bath ,, ..	204	16·0	Acid.
20	Sulphur Bay Spring ,, ..	90-100	5·6	Acid.
21	Otumuhika (*a*) Taupo ..	100-150	1·5	Sulphurous.
22	,, (*b*) ,, ..	150	3·4	Sulphurous.
23	,, (*c*) ,, ..	78	1·2	Sulphurous.
24	Ruahine ,, ..	190	19·1	Sulphurous.
25	Orakeikorako ,, ..	90-106	10·6	Acid.
26	McMurray's Bath ,, ..	126	4·2	Sulphurous.
27	Alum Cave Spring, Taupo	60	7·1	Sulphurous.
28	Crow's Nest Spring, Taupo	170	18·0	Saline.
29	Waipakahi ,,	98-120	2·8	Sulphurous.
30	Te Hukahuka ,,	116	1·8	Sulphurous.
31	Tarawera ,,	130	12·5	
32	Parkes' Spring ,,	Cold	25·1	
33	Wangape, Waikato ..	160-200	6·0	Alkaline.
34	Onetapu ,, ..	70	58·0	
35	Roparoa, Waiapu ..	Cold	..	Saline, Bituminous.
36	Manutahi, ,, ..	Cold	..	Saline, Bituminous.
37	Pepoti, ,, ..	Cold	..	Hydro-carbon Gas.
38	Waipaoa, Poverty Bay ..	Cold	..	Bituminous.
39	Waipiro, Waiapu ..	144	..	Calcareous, Bituminous.
40	Wallingford, Wellington ..	60	10·4	Acid.
41	Pahua ,, ..	Cold	184·2	Alkaline.
42	Barton's Spring ,, ..	Cold	..	
43	Akateo (*a*) ,, ..	Cold	62·4	Alkaline.
44	,, (*b*) ,, ..	Cold	4·8	Sulphurous.
45	Hanmer Plain Springs, Amuri	90-104	10·8	Alkaline.
46	Sumner Lake Springs, Hurunui	93	2·3	Acid, Saline.
47	Amberley Spring, Canterbury	Cold	11·7	Chalybeate.
48	Wickliffe Bay Spring, Otago	..	34·6	Saline.
49	Gibson's Spring, Southland	Cold	2·3	Alkaline.

From the analyses of the mineral waters by Mr. Skey, the principal results of which have been published,* the following substances appear to be contained in solution :—

Silicates of soda
,, lime
,, magnesia
,, iron
Silica
Sulphate of soda
,, potash
,, alumina
,, lime
,, magnesia
,, iron
Chloride of sodium
,, potassium
,, calcium
,, magnesium
,, iron
Phosphate of alumina
Phosphoric acid
Lithia
Iron oxides
Hydrochloric acid (free)
Sulphuretted hydrogen
Sulphuric acid (free)
Bromide of magnesium
Iodide ,,
Carbonic acid (free)
Carbonates of soda
,, potash
,, magnesia
,, lime
Free ammonia
Albuminoid ammonia.

Non-Metallic Minerals.—Class II.

Carbon and Boron.

Graphite, C.—This mineral occurs somewhat widely distributed throughout New Zealand; but up to the present time has not been found in large enough quantities and of sufficient purity to induce anyone to work it

* Trans. N.Z. Inst., vol. x., p. 423.

continuously. Prior to 1865, however, 7 tons of manufactured plumbago from Pakawau, Nelson, valued at £1,400, were exported, but the trade has not been continued.

The first mention of its occurrence in New Zealand is by Dr. v. Hochstetter (New Zealand, 1863, p. 477, Eng. Ed.) where he says,—" The Bros. Curtis, in 1861, opened extensive beds of plumbago near Pakawau." Dr. Hector also (Jurors' Rep. N. Z. Ex., 1865, pp. 34 and 417) mentions its occurrence at Pakawau, near Collingwood, as thick beds interstratified with metamorphosed shale. Compressed samples were found to be quite equal in colour and brilliancy to that commonly sold in paper packets for domestic purposes. Analyses of these samples showed that they contained :—

	(1.)	(2.)	(3.)
Carbon ..	37·60	30·03	58·10
Water ..	2·00	1·35	2·68
Ash	60·40	68·62	39·22
	100·00	100·00	100·00

He, also, in the same report (p. 267), mentions its occurrence as scales in the marble of the West Coast, and Mr. J. C. Crawford (Essay on the Geology of the Wellington Province, p. 5) says,—" Thin seams of an impure graphite are found at a great variety of places :—on the Pitone Road, near Wellington ; at the Mungaroa Hill ; at various points on the Rimutaka Mountains ; in the mountain part of the valley of the Waiohine; the Waingawa and the Ruamahunga ; in the Waikanae, the Akaterewa and particularly in the upper part of the Otaki Valley." Dr. Hector (Trans. N.Z. Inst., vol. ii., p. 379) again refers to the deposit of plumbago at Pakawau, stating that it has probably been derived from an altered portion of a coal seam ; and (Trans. N.Z. Inst., vol. x., p. 490) Prof. Liversidge also mentions the occurrence of graphite at Few's Creek, Lake Wakatipu, and Dunstan, Otago—both samples being of an impure nature.

During 1878 a sample of graphite shale was forwarded to the Colonial Museum by the Hon. Mr. Acland, as coming from the Malvern Hills; in 1871 samples were forwarded from Wakamarama by Mr. A. J. Burne, which contained from 31·14 to 22·59 per cent. of carbon ; in 1876 a graphitic sandstone was forwarded from Jackson's Bay by the Hon. J. A. Bonar, containing 10·42 per cent. of carbon ; and in 1878 Mr. McKay collected a very pure sample of graphite, from the *Glossopteris* beds of Mt. Potts, which contained 90·17 per cent. of carbon, the colour of the ash being reddish. " Although so rich in carbon, it has not that unctuousness which distinguishes the more valuable graphites, but appears indurated and granular defects which must depreciate its value very considerably," (Lab. Rep. xiii., p. 22),

During the same year another sample of graphite was forwarded by Mr. Beere from the vicinity of Wellington, in which the percentage of carbon was 66·71; and Mr. P. C. Cheal also forwarded a very pure sample of graphite from Waiokura Creek, Waimate, Taranaki, the specimen having been found in the bed of a creek. In 1879 Mr. W. Docherty forwarded specimens of mica schist from Dusky Sound, in which scales of graphite were found; and in 1880 Mr. C. W. Tripp sent samples of graphite slate from the Orari Gorge, which contained 20·62 per cent. of carbon.

The only samples of this mineral which merit special description are those from Pakawau, Mount Potts, and Waiokura Creek.

Graphite.—Pakawau. Compact, with lamellar and petaloidal structure; requires purification to render it of commercial value (Liversidge, Trans. N.Z. Inst., vol. x., p. 490); it is more or less schistose, and varies a good deal as regards purity.

Graphite.—Mt. Potts. Finely laminated; black and shining; powder soft, soiling the fingers; hardness about 1, but including small grains which are harder. Does not feel greasy to the touch. Appears to be an intermediate form between anthracite and graphite.

Graphite.—Waiokura Creek. A solid compact homogeneous form, separated in distinct laminæ about $\frac{1}{16}$ inch thick with siliceous partings at places. Hardness a little over 1. Colour iron-black with black and shining streaks. Mark on paper corresponds with H. pencil. Has only been found as isolated boulders, the enclosing rock being unknown. It is an extremely valuable form of this mineral.

Coal.—This mineral is widely distributed throughout New Zealand, but samples from different localities vary greatly in their composition and value as fuel. In 1866 Dr. Hector (First General Coal Report) divided these into Hydrous and Anhydrous coals, or those which still contain a large percentage of water chemically combined with them, and those which we may assume to have been deprived of that water by a chemical change, which, in some cases, may have been induced by causes operating feebly throughout lengthened periods, or, in others, has been rapidly effected on more modern deposits of carbon, under circumstances which favoured a more energetic action. The large number of analyses which were subsequently made of the different classes of coals, together with a careful study of their prevailing characteristics, rendered it necessary to further subdivide them, and in 1872 Dr. Hector (Geological Reports, 1871–72, p. 172) proposed the following classification, which has proved so satisfactory that I cannot do better than adopt it in my present paper:—

I. Hydrous (coal containing 10 to 20 per cent. of permanent water.)

a. Lignite.—Shows distinct woody structure; laminated or shows that structure on desiccation; very absorbent of water.

b. Brown Coal.—Rarely shows vegetable structure. Fracture irregular, conchoidal, with incipient lamination; colour dark brown; lustre feeble; cracks readily on exposure to the atmosphere, losing 5 to 10 per cent. of water which is not reabsorbed; burns slowly; contains resin in large masses.

c. Pitch Coal.—Structure compact; fracture smooth, conchoidal; jointed in large angular pieces; colour brown or black; lustre waxy; does not desiccate on exposure, nor is it absorbent of water; burns freely and contains resin disseminated throughout its mass.

II. Anhydrous (coal containing less than 6 per cent. of water).

a. Glance Coal.—Non-caking, massive, compact or friable; fracture cuboidal, splintery; lustre glistening or metallic; structure obviously laminated; colour black; does not form a caking coke, but slightly adheres. This variety is chiefly brown coal altered by igneous rocks, and presents every intermediate stage from brown coal to anthracite.

b. Semibituminous Coal.—Compact, with laminæ of bright and dull coal alternately; fracture irregular; lustre moderate; cakes moderately or is non-caking.

c. Bituminous Coals.—Much jointed, homogeneous, tender and friable; lustre pitch-like, glistening, often iridescent; colour black with a purple hue; powder brownish; cakes strongly, the best varieties forming a vitreous coke with brilliant metallic lustre.

Hydrous Coals.

Lignite.—Deposits of lignite occur widely distributed throughout New Zealand, and in Otago and Southland, as pointed out by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 374); they occur scattered over the surface of the primitive slate rocks of the interior. They are of recent tertiary age, being only overlaid by the newer drifts in the form of brick clays, ferruginous gravels, silts and shingle terraces. One of the most important of these lignite deposits is that near Mataura, in Southland, where a seam from 6 feet to 20 feet in thickness is worked by a number of small open casts for the local requirements of the district, and another important deposit of a similar nature, but from 9 feet to 30 feet thick, is also worked in the interior of Otago at Naseby, Kyeburn, and Hyde. Besides these, many less important deposits of lignite occur throughout New Zealand; thus near Te Anau Lake there are seams about 2 feet thick, and throughout the Lower Waikato basin and near Raglan further deposits occur, some of the outcrops being several feet in thickness, but they are not worked owing to brown coals being more accessible and of better quality. Between

Napier and Masterton, again, somewhat extensive deposits of the lignite series are met with, in which, however, the seams of lignite are of no great thickness and have received but little attention.

Brown Coal.—The principal deposits of brown coal in New Zealand belong to the cretaceo-tertiary formation, and, as pointed out by Dr. Hector (Geol. Rep., 1878–79, p. 7), they are always at the base of the marine portion of the series in every locality where they occur. They always rest upon the basement rock of the district, marking a great unconformity and a long-persistent land area at this period.

Thus they are overlaid by the *Leda* marls in the Waikato, the fucoidal greensands at Whangarei, and by the island sandstone in Otago and on the West Coast of the South Island.

They are the most widely-distributed class of coals, being largely represented in Auckland, Canterbury, Otago, Southland, and Nelson.

In Auckland the coal from the Waikato is of an inferior character. It does not stand the weather well, and has a high percentage of water. The average composition of these coals is—

Fixed carbon	47·08
Hydro-carbon..	33·24
Water	17·60
Ash	2·08
	100·00

Two mines are at present being worked in these deposits, one, the Huntly Mine, having a seam from 6 feet to 40 feet thick, and the other, the Waikato Mine, a seam from 10 feet to 18 feet in thickness. Besides these, the Bridgewater Colliery, near the Miranda Redoubt, which is now closed, was working a seam no less than 53 feet thick.

In Nelson there are a few seams of brown coal, none of which are at present being worked. Amongst these is a highly-inclined seam at Richmond near the town of Nelson, another at Karamea, and at Charleston, near Westport, a large seam of brown coal occurs over a considerable area of flat country, but is not worked since coal of better quality is near at hand.

Taking an average of the analyses which have been made of these coals, their composition is as follows :—

	Fixed carbon.	Hydro-carbon.	Water.	Ash.
Richmond ..	48·82	37·15	9·04	4·99
Karamea ..	38·90	37·29	16·36	7·45
Charleston ..	40·82	33·16	21·09	4·93

In Westland no seams of brown coal have been worked, but a few samples have been forwarded from the Grey Coal Reserve, which have the following average composition :—

Fixed carbon	46·93
Hydro-carbon	31·13
Water	18·42
Ash	3·52
	100·00

In Southland, mines have lately been opened in two seams of coal at the Nightcap Hill above Wairio, in which the composition of the coal is as follows :—

Fixed carbon	47·81
Hydro-carbon..	21·04
Water	29·24
Ash	1·91
	100·00

and another thick seam is known at Orepuki, which will probably be worked as soon as railway communication has been established. It consists of—

Fixed carbon	41·21
Hydro-carbon..	39·09
Water	11·14
Ash	8·56
	100·00

In Canterbury, a valuable series of brown coals exists in the Malvern Hills, which have often been locally altered, in the vicinity of intrusive rocks of later origin, to various stages between brown coals and anthracites. Mines are at present being worked in the unaltered brown coals at Springfield, Smithfield, Canterbury, Homebush, and Lees, in seams from 3 feet to 7 feet 6 inches thick, in which the quality of the coal often varies a great deal even between the top and bottom of the same seam. As an instance of this I may quote the analyses of the top and bottom of the 4½ feet seam at Springfield, from which it will be seen that the upper part was a glance coal, while the lower had the composition of a very good pitch coal.

	Top of Seam.	Bottom of Seam.
Fixed carbon	63·2	47·9
Hydro-carbon	23·6	41·8
Water	3·2	6·3
Ash	10·0	4·0
	100·0	100·0

The average of thirteen analyses of the true brown coals from this district give

Fixed carbon	42·87
Hydro-carbon..	31·89
Water	20·40
Ash	4·84
	100·00

as their composition, the fixed carbon varying from 49 to 38 per cent., and the water from 18 to 24 per cent. The coal from the different mines does not vary a great deal in character, for good and inferior samples can be obtained from each.

Besides that at the Malvern Hills, there are two seams of brown coal, each 10 feet thick, at the Rakaia Gorge, of which the average composition is—

Fixed carbon	45·76
Hydro-carbon..	26·62
Water	18·71
Ash	8·91
	100·00

and at Mount Somers a seam 25 feet thick occurs, having a composition of—

Fixed carbon	39·60
Hydro-carbon	39·20
Water	8·80
Ash	12·40
	100·00

In Otago there are brown coals of an inferior character near Oamaru; at the Green Island near Dunedin; and several other localities in which small mines only have been opened to supply local demands.

The Green Island Mines, of which there are seven, are working seams of coal from 13 feet to 19 feet thick, and to a great extent supply Dunedin with household fuel. The coals have an average composition of

Fixed carbon	40·84
Hydro-carbon	36·57
Water	18·67
Ash	3·92
	100·00

At Oamaru the seams of coal are from 6 feet to 25 feet thick, but the output is very limited, the four mines at work having only yielded 3,770 tons during the year 1881. Their average composition is—

Fixed carbon	39·76
Hydro-carbon	35·60
Water	17·18
Ash	7·46
	100·00

Besides these coals there is an important basin of a better class of brown coals in the Clutha and Tokomairiro districts, as well as at Shag Point, in which several mines have been opened. Of these the Kaitangata Colliery is working a seam 30 feet thick; Eliott Vale, 20 feet; Real McKay 25 feet; and Bruce 12 feet 6 inches. At Shag Point the Shag Point Mine is being worked in a seam 7 feet in thickness. The superiority of these coals over that from Green Island appears to depend upon their having a solid compact roof instead of the loose running sands of the latter locality. Their average composition is—

	Fixed carbon.	Hydro-carbon.	Water.	Ash.
Kaitangata	44·17	38·24	15·42	2·17
Eliott Vale	41·60	35·31	19·48	3·61
Real McKay and Bruce ..	41·29	40·19	12·37	6·15
Shag Point	43·15	33·70	16·57	6·58

Pitch Coals.—The distinguishing characteristic of these coals is that they do not desiccate on exposure to the air to the same extent as the brown coals, besides which they, as a rule, contain a less proportion of water in combination. They are chiefly met with as seams which overlie the bituminous coals of the west coast of the South Island, where however they have only been worked in the Reefton district and at West Wanganui. They are again met with at Mokau in Taranaki, and at Whangarei. Some of the altered coals of the Malvern Hills, Canterbury, might also be classed with these coals, but since they represent various stages of change from brown coals to anthracites, it is best to group them together under the title of glance coals.

The pitch coals of the West Coast may be divided into those from West Wanganui, those from Inangahua, those from the Buller, and those from the Grey districts, of which only the two first have been worked. The seams vary from 2 feet to 10 feet in thickness, and the composition is as follows:—

	Fixed carbon.	Hydro-carbon.	Water.	Ash.
Buller	42 40	36·60	9·20	11·80
Greymouth	40·70	45·61	7·37	6·32
Reefton (Inangahua) ..	59·54	30·93	9·07	·46
West Wanganui	45·00	38·90	4·80	11·30

At Mokau the coal seams vary from 2 feet to 6 feet in thickness, and a trial of the coal against Waikato showed it to be one-fourth better, 1½ tons of the Mokau coal doing as much as 2 tons of the best Waikato (Hector, Geol. Rep. 1879–80, p. 21). The composition of these coals is—

Fixed carbon	52·10
Hydro-carbon	34·00
Water	11·20
Ash	2·70
	100·00

At Whangarei two mines are at present at work—viz., Kamo mine, in which there are two seams 4 feet to 4½ feet and 8 feet to 12 feet thick respectively; and the Whau Whau mine, in which the seam is from 5 feet to 9 feet thick; besides which outcrops of coal occur at Whareora 3 feet to 3 feet 6 inches thick; and at Hikurangi, ten miles from Whangarei, there are numerous outcrops of coal from 2 feet to 6 feet thick.

The average composition of these coals from a number of analyses is:—

	Fixed carbon.	Hydro-carbon	Water.	Ash.
Kamo	48·83	38·60	8·98	3·59
Whau Whau ..	47·50	41·45	7·59	3·46
Whareora ..	45·94	38·79	7.06	8·21
Hikurangi ..	43·41	45·67	6·16	4·76

making the average analysis of the coals from the Whangarei field—

Fixed carbon	46·42
Hydro-carbon..	41·13
Water	7·45
Ash	5·00
	100·00

Anhydrous Coals.

Glance Coals.—These, which are brown coals, altered variously in the vicinity of certain dykes and flöes of dolerite, are only met with as workable seams in the Malvern Hills coalfield, where they occur as seams from 2 feet to 10 feet thick. They occur in all stages of change from brown coals to anthracites, and some of them might, with propriety, be classed under the subdivision of pitch coals, but since they all belong to a series, I have thought it better to group all that have undergone any degree of change under the present head, those in which the percentage of water is high being left with the brown coals. Some of these with a high percentage of water however, exhibit signs of change, the percentage of fixed carbon to hydro-carbon being large, as in the case of the seams at the Rakaia Gorge, already quoted. The following table of analyses shows how varied they are

in composition, and, as previously mentioned, the top and bottom of the same seam will frequently be quite different:—

	Fixed carbon.	Hydro-carbon.	Water.	Ash.
Springfield	47·90	41·80	6·30	4·00
Brockley	49·99	35·22	11·79	2·80
Springfield	50·60	38·80	7·80	2·80
Ayers (thin seam) ..	52·01	3·69	4·89	39·41
Brockley	53·29	32·04	12·65	2·02
Hill's mine	53·30	33·97	9·98	2·75
Springfield	55·50	30·90	4·20	9·40
Hill's mine	59·39	33·78	3·89	2·94
Williamson's	61·90	26·80	·90	10·40
Kowhai	61·10	35·40	1.60	1·90
Ayers (thick seam) ..	62·21	18·99	5·20	13·60
Springfield	63·20	23·60	3·20	10·00
Rakaia Gorge	64·51	21·27	6·76	7·46
Acheron	65·80	5·38	4·57	24·25
Kowhai	66·10	14·10	2·20	17·60
Malvern Hills	67·49	17·89	2·12	12·50
Hart's mine	69·62	14·92	2·77	12·69
Malvern Hills	73·94	16·60	3·60	5·86
Kowhai..	80·01	10·95	6·50	2·54
Malvern Hills	83·20	12·10	2·20	2·50
Acheron	88·91	—	3·17	7·92

Semibituminous Coals.—The only coals of this class of which we know anything are those from the well-known Kawakawa colliery at the Bay of Islands, the output from which for the year 1881 was 50,277 tons, or about $\frac{1}{7}$ of the total quantity of coal raised in New Zealand during that year. The mine is worked in a seam which is from 4 feet to 15 feet thick, and the coal has an average composition of—

Fixed carbon	55·59
Hydro-carbon..	38·10
Water	4·19
Ash	2·12
	100·00

It varies a good deal in its physical characters, being sometimes exceedingly hard and at others quite soft, but the composition is moderately constant. It is an excellent steam coal, and is largely used on the coasting steamers.

The same class of coal also occurs at Preservation Inlet in Otago, where it is found in thin impure seams, having the following average composition:—

Fixed carbon	61·37
Hydro-carbon..	28·06
Water	4·37
Ash	6·20
	100·00

Besides which there are numerous small seams, 10 inches thick and less, occurring in the jurassic strata in various localities, as the Hokanui Hills and Mataura, Southland; Waikawa, Otago; and the Waikato Heads, Auckland; in fact wherever the formation occurs, but since they have never been found in seams which are of sufficient thickness to work remuneratively they do not merit any special attention.

Bituminous Coals.—These coals are, so far as is at present known, exclusively confined to the west coast of the South Island. At Collingwood they occur as thin seams from 27 inches to 32 inches in thickness; one mine being at present at work in this district. The average composition of the coal from this locality is—

Fixed carbon	53·29
Hydro-carbon..	38·18
Water	2·06
Ash	6·47
	100·00

At Westport seams of bituminous coal occur from 4 feet to 50 feet in thickness, and two mines are at present at work. The estimated quantity of coal in this field, from accurate surveys, is 140,000,000 tons, which is probably considerably below the mark. All the coal is level, free, and generally at an elevation of from 1,000 to 3,000 feet above the sea. The average composition of the coal is—

Fixed carbon	63·81
Hydro-carbon..	31·88
Water	3·08
Ash	1·23
	100·00

There are also two small areas of highly-inclined, faulted coal, which is much crushed, and too tender to be marketable. It has the following composition:—

Fixed carbon	75·05
Hydro-carbon	21·29
Water	1·40
Ash	2·26
	100·00

Two mines have been opened to work this coal, but both are now abandoned.

At Greymouth another series of bituminous coals has been worked in which the percentage of fixed carbon is considerably less than in that from Westport. It is, however, an exceedingly valuable gas coal, and the coke made from it is as good as can be procured. The seams vary in thickness

from 7 feet to 17 feet, those which have been worked hitherto being all 12 feet thick or over. Two mines are at present at work here, but another which has been sold will, it is probable, be shortly at work again, and a new company is being formed to open up another lease. The average composition of these coals is as follows:—

Fixed carbon	53·25
Hydro-carbon	38·73
Water	1·48
Ash	6·54
	100·00

There is also a small deposit of coal at Kanieri in Westland, of which the composition is—

Fixed carbon	47·50
Hydro-carbon	30·17
Water	1·87
Ash	20·46
	100·00

and outcrops are also known farther south near the Paringa River, but no work has been expended in opening them up.

The question of the evaporative power of the different coals is now receiving the attention of the department, since it has been found that the number which theoretically represents the number of pounds of water which can be converted to steam, by the combustion of a pound of each coal, is only approximately true for the hydrous varieties, giving them a higher theoretical power than in practice they are found to possess.

Bituminous Peat.—Chatham Islands. This mineral is described (Col. Mus. and Lab. Reports, iii., p. 11) as follows:—

"Colour, black; somewhat vesicular, otherwise very compact; lustre, rather dull generally, bright jet on margins of vesicles. Burns freely to a white ash with much flame; when once set fire to, all the carbonaceous matter is consumed without re-ignition. Does not cake; powder of mineral brown; ash, alkaline; sulphuretted hydrogen cannot be detected in its smoke.

	Analysis in its normal condition.	Analysis after exposure to air until its weight is constant.
Fixed carbon	19·87	20·41
Hydro-carbon	64·67	66·43
Water	7·13	4·61
Ash	8·33	8·55
	100·00	100·00

Percentage of fixed carbon, deducting water and ash	23·51
Percentage of hydro-carbon, deducting water and ash	76·49
	100·00

"This mineral was first discovered by Mr. Traill, occurring in detached masses of irregular form and considerable size in the superficial gravels and peat deposits at most points along the low eastern shore of the Chatham Islands. It appears to have no connection with the brown coal and lignite deposits which occur in the same island; nor could Mr. Traill discover any distinct bed or seam of this mineral. It is very interesting on account of its highly bituminous character, resembling that of the oil-shale found at Mongonui, Auckland."

A similar mineral is found on the Auckland Islands, and is mentioned by Dr. Hector (Trans. N.Z. Inst., vol. ii., p. 183).

Bituminous Shale.—A mineral closely approximating to Torbanite is mentioned by Dr. Hector (First Coal Report, 1866, p. 44) as coming from Awatere, near Mongonui, Auckland. It is very coherent, close-grained, hard and tough, almost elastic, does not show the slightest indications of lamina or cleavage planes, having a smooth semi-conchoidal fracture in every direction. Colour, dull black; perfectly homogeneous; powder, brown or chocolate colour; sp. gr. 1·112; ignites with ease and bursts into flame, which is sustained for a long time and with great vigour. Flame at first luminous and bright, but soon becomes long and smoky. During combustion small oil-bubbles are seen escaping. Heated to dull red heat in closed crucible, 23 per cent. of light, non-coherent, cellular and slightly lustrous coke remains, which burns readily in free access of air to a white ash.

ANALYSIS.

Volatile matter ..	75·20
Carbon in coke ..	9·30
Hygroscopic water ..	1·80
Ash	13·70
Sulphur	traces
	100·00

Relative percentage of

Volatile matter ..	88·99
Fixed carbon	11·01
	100·00

Carbonaceous Shale.—A mineral having the composition of—

Fixed carbon	14·96
Hydro-carbon..	39·39
Water	6·74
Ash	38·91
	100·00

occurs at Orepuki, Southland, and is reported on (Col. Mus. and Lab. Reports, xi., p. 11), and another from Blueskin Bay, Otago, is also mentioned (Col. Mus. and Lab. Reports, xiii., p. 21), which is composed of—

Fixed carbon	13·81
Hydro-carbon..	29·78
Water	10·76
Ash	45·65
	100·00

These are only hydrous shales containing a certain percentage of carbonaceous matter, and are not of any use for the distillation of oil.

Carbonaceous Mineral, Whangarei.—This is described by Captain Hutton (Trans. N.Z. Inst., vol. iii., p. 250) as follows:—"Colour black, with shining resinous lustre; streak and powder, black; very brittle, but does not dirty the fingers. H. about 2. In the flame of a spirit lamp it burns to a white ash without altering its shape, and without giving off any odour or smoke, but it will not burn if taken out of the flame. It appears to be nearly pure carbon without any admixture of bitumen. Dr. Hector gives the following composition for this mineral:—

Fixed carbon	34·20
Hydro-carbon	17·00
Water	32.20
Ash	16·60
	100·00

from which it appears to be a non-caking lignite approaching jet, burning with difficulty, giving but little flame, and a white ash.

Elaterite (Elastic Bitumen), CH_2.—The occurrence of this mineral on the coast of the North Island is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 425) as easily impressed by the nail, and perfectly free from any impurities. Prof. Liversidge (Trans. N.Z. Inst., vol. x., p. 491) again mentions its occurrence at Poverty Bay, the following being his description of the specimen:—"The exterior surface is of a brown colour, within it is black, burns with a luminous smoky flame, emitting a bituminous odour; leaves a small quantity of white ash; breaks with conchoidal fracture; very brittle; possesses bituminous odour."

It has only up to the present time been found as pieces on the East Coast of the North Island, and on the Island of Kawau, and may possibly not be a natural product, but lost from some ship.

Petroleum.—The first mention of this mineral oil is by Dr. Hector (Geol. Rep., 1866–67, p. 4), where he describes its mode of occurrence at Taranaki, and he has also (Geol. Rep., 1873–74, p. xviii.) given a description of the oil-springs at Poverty Bay.

Mr. Skey has, in a paper on the mineral oils of New Zealand (Trans. N.Z. Inst., vol. vi., p. 253), given a very good description of their physical characters.

1. *Sugar Loaves, Taranaki*.—A very remarkable oil having sp. gr. ·960 to ·964 at 60° Fahr., dirty green colour by reflected light; opaque, except in thin films, when it has a deep red colour by transmitted light. At 60° Fahr. is quite liquid, and though at lower temperature it has considerable consistency, yet when reduced to 5° Fahr. it does not become solid. Has

a mawkish but not unpleasant odour, being very different in this respect from most rock oils, and is especially free from all traces of sulphuretted hydrogen. Minute flakes of a white substance float in the oil, and are gradually deposited when it is allowed to remain quiet at a low temperature, nearly the whole of this solid substance becoming dissolved when the oil is gently heated. Boils at 340° Fahr., and does not appear to evaporate at ordinary temperatures. Vapour inflames at 260° Fahr.; does not contain paraffin. Very valuable as a lubricant on account of its low freezing and high volatilizing points.

2. *Poverty Bay.*—A true paraffin oil. Opalescent and thickly interspersed with minute flaky particles of a white colour; by warming the oil gently these particles subside, and the oil manifests the following characters: translucent in masses of considerable thickness; colour, red by transmitted and blackish-green by reflected light; flows readily and gives off the usual odour of crude petroleum. Its boiling-point at 30 ins. barometric pressure varies from 289° to 291° Fahr. The temperature at which the vapour inflames is from 230° to 233° Fahr., and sp. gr. from ·864 to ·871 at 60° Fahr. Passes into a jelly-like mass at 50° Fahr., owing to the quantity of paraffin dissolved in the oil.

3. *Manutahi, Waiapu River.*—Is the lightest natural mineral oil known in the colony. Colour, pale brown; nearly or quite transparent; does not manifest a green-black colour by reflected light; flows with great freedom; has the odour of kerosene; sp. gr. ·8294 at 60° Fahr.; burns well in a kerosene lamp for some time. Contains only traces of paraffin, and does not acquire any increased consistency when the temperature is lowered to 8° Fahr.

For details concerning the constitution of these oils I must refer the reader to the paper above cited, and also to another by the same author (Trans. N.Z. Inst., vol. xi., p. 469).

Dopplerite.—A mineral grease resembling dopplerite was collected by Dr. Hector from Waiapu in 1872, and during 1880 a specimen of the same mineral was forwarded to the Colonial Laboratory for examination on the supposition that it was ozokerite or native paraffin.

This substance is of a soft greasy nature, brownish-yellow colour, and possesses a strong odour of paraffin. It burns readily with a smoky flame, leaving a large quantity of ash, and consists, according to Mr. Skey (Trans. N.Z. Inst., vol. xiv., p. 398) of 3·1 per cent. oils; 9·3 per cent. paraffin; 26·9 per cent. earthy matter; 11·3 per cent. water; and 49·4 per cent. oxygenated hydro-carbons.

Ozokerite, CH.—This mineral is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 267, 438) as occurring in the brown coals of Dunstan, Otago. We have, unfortunately, no specimen of this.

Ambrite (Retinite).—Dr. v. Hochstetter is the first to mention the occurrence of this mineral in New Zealand (New Zealand, 1863; Eng. ed., p. 79). He describes it as follows:—"Fossil resin imbedded in the coal, sometimes in pieces from the size of a fist to that of a man's head, but usually only in smaller groups. It is transparent, very brittle, and has a conchoidal and quite glossy fracture. Colour changes from a bright yellow to dark brown; is easily ignited, much more so than the kauri gum; burns with a steady fast sooting flame, and developes a bituminous rather than aromatic smell. Mr. Richard Maly found as a mean of three chemical analyses of this fossil resin—

Carbon	76·53	Computed	76·65
Hydrogen	10·58	"	10·38
Oxygen	—	"	12·78
Ash	·19	"	·19
			100·00

yelding the formula $C^{32} H^{26} O^{4}$. It shows great indifference to solvents; by friction it becomes electric; H. 2, sp. gr. 1·034 at 12° R. It is sufficiently characterized to deserve a special name, but it comes so near to real amber in composition that it deserves the name of Ambrite."

Dr. Hector also mentions its occurrence (Jurors' Rep. N.Z. Ex., 1865, p. 426) under the name of Retinite, in the brown coals of Hyde, Caversham, Tuapeka, Waitahuna, and Dunstan; and Professor Liversidge (Trans. N.Z. Inst., vol. x., p. 490) again describes samples from Dunstan and the Bay of Islands. It is of common occurrence in the brown coals of New Zealand wherever they occur, being sometimes in moderately large blocks, and at others as dispersed grains.

Mellite, $\dddot{\underline{Al}}\ \overline{M}^{3} + 18\ \dot{H}$.—A specimen of this mineral was first collected by Captain Hutton from the Thames in 1870, and the specimen is described (Col. Mus. & Lab. Reps., vi., p. 15) as a resinous looking substance, with a splintery fracture. Another specimen was collected by Dr. Hector in 1876 from a cave in Bligh Sound, and is mentioned in the Twelfth Laboratory Report under the number 1915. There is no description and none of the mineral remains.

Non-Metallic Minerals.—Class III.

Sulphur and Selenium.

Sulphur, S.—Considerable quantities of this valuable mineral occur on White Island, where it is deposited from numerous geysers and an enormous boiling spring near the centre of the island (Hector, Jurors' Rep. N.Z. Ex., 1865, pp. 34, 425), and it occurs in smaller quantities on various other islands in the Bay of Plenty. It is also deposited from fumaroles at the Rotomahana hot lakes and Taupo, and in several other localities where hot

springs occur (Hochstetter, New Zealand, 1863, Eng. ed., p. 401). It is found again as an efflorescence on the sulphur sands of lower cretaceous age at Waipara (Haast, Geol. Rep., 1870–71, p. 11), and at various other localities; and the late Mr. E. H. Davis mentions its occurrence (Geol. Rep., 1870–71, p. 131) in Doran's No. 2 Reef, at Wangapeka. Analyses of samples from White Island have given the following results:—

	Liversidge.			Cox.		
Sulphur	99·614	99·554	98·888	99·9	94·1	62·5
Foreign matter ..	·386	·446	1·112	·1	5·9	37·5
	100·000	100·000	100·000	100·0	100·0	100·0

They vary in physical characters from a massive rich sulphur yellow mineral to a loose friable variety with a pale-greenish tinge and some very beautiful, although small, crystals also occur. These are of a pale-greenish colour, and consist chiefly of sharp acicular rhombic prisms; but some very unusual combinations also occur which have been described by the late Mr. E. H. Davis (Trans. N.Z. Inst., vol. iii., p. 284). They are frequently associated with crystals of selenite.

Selenium, Se.—Prof. Liversidge (Trans. N.Z. Inst., vol. x., p. 491) states that he obtained traces of selenium in the massive yellow variety of sulphur from White Island.

Non-Metallic Minerals.—Class IV.

Haloids and Salts. { Salts of ammonia, potash, soda, baryta, strontia, lime, magnesia, alumina, yttria, and ceria.

Salts of Soda.

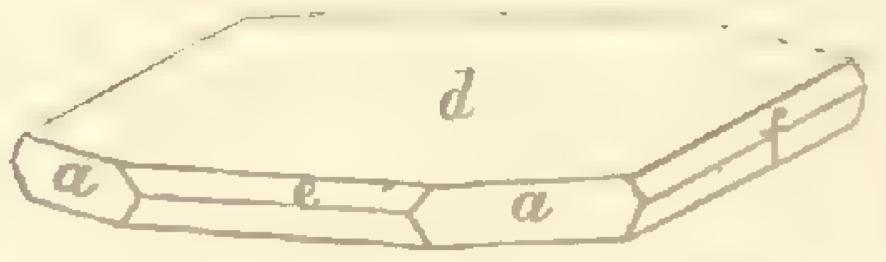
Glauber Salts, $\dot{Na}\,\ddot{S} + 10\,\dot{H}$.—A specimen of this mineral was forwarded for determination by Mr. W. H. Beetham in 1874. The locality of its occurrence is Brancepeth, Whareama, Wellington.

Salts of Baryta.

Barytes, $\dot{Ba}\,\ddot{S}$.—This mineral was collected by Dr. Hector from Akiteo in 1867, and Mr. Skey mentions its occurrence (Geol. Rep. 1870-71, p. 85) in the auriferous reefs of the Thames. Mr. McKay collected a specimen from Paonui Point, near Napier, in 1874, and specimens have also been received from Te Arai Point, Auckland, and from near East Cape. The following specimens are at present in the collection of the Colonial Museum:—

1. *Crystals of Barytes.*—Crown Princess Claim, Thames. Of a pure white colour, the largest crystal being about half an inch long. They are of a tabular form, consisting of the prism ∞P; the brachypinacoid $\infty\breve{P}\infty$ and the basal pinacoid OP, but in some forms the brachypinacoid is replaced by small faces of the brachydome $\breve{P}\infty$.

2. *Crystals of Barytes.*—Thames. A very interesting specimen, consisting of an encrustation of small white transparent crystals, the largest being about $\frac{1}{8}$ inch across. These crystals are all tabular, and consist of the prism ∞P (*a*), the macropinacoid $\infty \bar{P} \infty$ (*b*), the brachypinacoid $\infty \breve{P} \infty$, and the basal pinacoid OP (*d*), thus forming octagonal plates. In some crystals the macro- and brachypinacoids are developed to the extinction of the planes of the prism, when four-sides tabular plates are formed, and in others again the macrodome $\frac{1}{2} \bar{P} \infty$ (*e*) and the brachydome $\breve{P} \infty$ (*f*) either bevel the edges of the macro- and brachypinacoid or completely extinguish them, giving rise to the following crystals :—



3. *Barytes with Quartz.*—Opotiki. A massive variety of a yellowish colour cementing irregular pieces of quartz. This specimen was presented to the museum by the late Rev. Richard Taylor.

4. *Radiating Barytes.*—Waikouaiti. A specimen presented to the museum by the Hon. W. B. D. Mantell, M.L.C.

Witherite, $\dot{Ba}\ddot{C}$.—The occurrence of this mineral in some of the mines at the Thames is mentioned by Mr. Skey (Geol. Rep., 1870-71, p, 85), but we have not, unfortunately, any specimen in the museum collection.

Salts of Lime.

Calcite, $\dot{Ca}\ddot{C}$.—This mineral is so widely distributed in New Zealand in various forms that it is unnecessary to refer to every instance of its occurrence which has been mentioned.

Crystallized Calcite.—Dr. Hector mentions its occurrence in the tertiary rocks of Otago (Jurors' Rep. N.Z. Ex., 1865, p. 3), as Dogtooth Spar in limestone at Moeraki, and as Iceland Spar in limestone, marble, etc. (Jurors' Rep. N.Z. Ex., 1865, p. 437); and Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 256) mentions it in cavities of the volcanic rocks of Canterbury. Professor Liversidge also (Trans. N.Z. Inst., vol. x., p. 491) mentions 16 different specimens of calcite from Dunedin, which are all crystallized as rhombohedrons or combinations of the rhombohedron and scalenohedron. In the Colonial Museum we have the following specimens :—

Calcite with Pyrites, Thames.—A massive crystalline variety with rhombohedral cleavage and small rhombohedral crystals in cavity. Colour, white.

Calcite with Natrolite, Dunedin.—Small rhombohebral crystals R, and also acute rhombohedrons in cavity in basaltic rock. Colour, pure white and transparent, to dirty grey.

Calcite.—Thames. The terminal end of a large scalenohedron on which an incrustation of small rhombohedral crystals has formed.

Calcite with Aragonite.—Seacliff, near Waikouaiti. A number of small obtuse rhombohedrons built up, one on the other, giving the whole crystal the appearance of a hexagonal prism with serrated edges, and with terminal rhombohedral planes. It is in a cavity in basalt.

Calcite.—Seacliff. A similar specimen to the last, but less perfect.

Calcite.—Cape Rodney. A block of white rhombohedral crystals of large size.

Smoky Calcite.—Cape Rodney. A slab of beautiful rhombohedral crystals of calcite of a smoky colour.

Calcite (Dogtooth Spar).—Tararu Creek, Thames. A large slab of breccia with acute rhombohedral crystals of a pale yellow colour on the face.

Massive Crystalline Calcite.—In this form calcite is of common occurrence as veins traversing many different sorts of rocks. It notably occurs in the slate of the Tokatea Range at Coromandel, and in the mines of the Thames, where, owing to its decomposition in contact with acids, the carbonic acid gas is formed which is found in such large quantities at the lower levels of the mines, sometimes rendering futile all attempts at ventilation. It is also frequently met with as large veins in the Maitai limestone of lower carboniferous age both in Nelson and Otago, and again associated with the crystalline marbles of the West Coast and Collingwood. It has also been found, under most interesting circumstances, in some of the granites of the West Coast Sounds, where it occurs as large rhombohedral masses entering into the composition of the rock as an accessory mineral.

Marble.—Some very fine deposits of marble occur in New Zealand, in Caswell and Milford Sounds on the West Coast, as mentioned by Dr. Hector (Report of Explorations of West Coast of Otago, "Provincial Gazette" and Jurors' Rep. N.Z. Ex., 1865, p. 3), and in the former locality a quarry has been opened out by a newly-formed company. The better varieties are of a pure white colour and saccharine texture; they are reported by Mr. McKay to occur moderately free from joints, and to be obtainable in large blocks (Geol. Rep., 1880-81, p. 115). There is also a coarser crystalline variety, as well as a black-veined marble, which occurs in considerable quantities. Marble of good quality again occurs at Collingwood and on the Riwaka Range between Takaka and Motueka, and a crystalline limestone, frequently called marble, is also found associated with the lower carboniferous rocks, and is met with in Nelson; the Blue Mountains, near Palmerston, Otago; and in the Clent Hills, Canterbury.

Madrepore Limestone.—At Reefton a limestone occurs, chiefly composed of large madrepore corals, which if cut and polished would afford a most beautiful ornamental stone.

Lithographic Limestone.—A stone suitable for most classes of lithographic work has been found in considerable quantities at the Abbey Rocks, Westland, and again at Amuri Bluff; but at the latter locality it is too much traversed by joints to be of any value.

Chalk.—Dr. Hector mentions (Trans. N.Z. Inst., vol. ii., p. 178) the occurrence of chalk with flints on Campbell Island, and during 1880 a deposit of chalk, not less than 100 feet thick, was discovered at West Oxford, Canterbury, of which Dr. Hector says (Geol. Rep., 1879-80, p. xviii.): "The samples of chalk obtained have more perfectly the mineral character and texture of English chalk than any previously discovered in New Zealand. The rock is pure white, fine-grained, and soft enough to be used for the manufacture of crayons.

"Its composition as determined by analysis is as follows:—

Calcic carbonate	82·26
Magnesic carbonate	1·84
Ferric oxide	traces
Silica	15·69
Water	0·21
	100·00."

Stalactites and Stalagmites occur in all the many limestone caves of New Zealand, some of them being of great size and beauty. Of these the caves at Whangarei, Waipu, Collingwood, and Mount Somers are well known for the variety in form and size in which these deposits of lime occur.

Travertine.—Dr. v. Haast mentions (Jurors' Rep. N.Z. Ex., 1865, p. 256) a deposit of travertine from calcareous waters at the Weka Pass, and it occurs on a small scale in many localities, but no large deposits are known.*

Limestone occurs very widely distributed throughout New Zealand in all degrees of purity and texture from a marl with 4 or 5 per cent. of carbonate of lime to a limestone which is nearly pure. Hydraulic varieties also exist, and at Mahurangi a deposit of this sort has been worked for some time past.

Aragonite, $\dot{C}a\,\ddot{C}$, is by no means of so common occurrence as calcite, but has still been found in a few localities. Dr. Hector mentions it (Jurors' Rep. N.Z. Ex., 1865, p. 266) in cavities in basaltic rocks at Dunedin, and

* A remarkable deposit of this mineral occurs on the Alfred River, a branch of the Maruia River, in terraces which are in the aggregate about 400 feet in height. They are chiefly composed of moss which has been petrified by the calcareous waters, and are now partially clothed by a fresh growth of this moss.

Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p, 256) states that it occurs lining fissures and cavities in the volcanic rocks of Banks Peninsula. In 1869, Capt. Hutton collected specimens from the Eldorado claim, Thames; in 1870 a specimen with calcite was forwarded from Oamaru by Mr. Traill; in 1875 Mr. McKay collected specimens from Whangaroa North, and in 1877 another from Waitaki. Prof. Liversidge (Trans. N.Z. Inst., vol. x., p. 493) describes four specimens from Dunedin, three of these being in amygdaloidal cavities, associated with calcite, and corresponding with the specimen I collected from Seacliff (mentioned under calcite, p. 381); the fourth being rosettes of pale yellow-coloured prisms. The acicular crystals of carbonate of lime mentioned by Dr. Hector (Handbook of N.Z., Melbourne Exhibition, 1880, p. 108) as deposited from a hot spring at Waipiro are also probably aragonite. The specimens in the Colonial Museum are:—

1. *Crystals of Aragonite.*—Eldorado Claim, Thames. A pure white transparent variety in prismatic crystals, consisting of the prism ∞P, the brachypinacoid $\infty \breve{P} \infty$, and the brachydome $\breve{P} \infty$.

2. *Crystals of Aragonite.*—Quartz hills, Collingwood. These include a large collection which I made during the summer of 1880, some of the groups of crystals being of exceeding beauty. They occur under somewhat unusual circumstances, having crystallized in small recesses about a foot deep in an isolated patch of limestone which occurs there. They consist chiefly of rhombic prisms, macled along a face of ∞P. They sometimes assume a more or less radiate form, but far more frequently interlace, forming a most beautiful network of fine acicular crystals. In some cases again they occur as little tufts of cream-coloured crystals about half an inch in diameter, and again as small bunches of acicular crystals, which are frequently terminated by very small stalactites. They are generally of a pale cream colour, but in some cases are brown, owing to the presence of ferric oxide.

Gypsum (*Selenite*), $\dot{C}a\ \ddot{S} + 2\ \dot{H}$.—This mineral occurs in several localities in New Zealand, either in groups of crystals associated with sulphur, as on White Island, where it also occurs in a massive form with sulphur disseminated through it; or as nests of crystals in clay or marl, as at Moeraki and Waihao. The first mention of it in New Zealand is by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 35, 266, 422, and 437), who states that it is found crystallized in clay at Moeraki, and also in lenticular masses at the same locality. It is again mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 256) occurring as crystals on the surface of tertiary shales at Tenawai. Dr. Hector also mentions the occurrence of gypsum (Trans. N.Z. Inst., vol. ii., p. 367) in the auriferous rocks of the Thames (Trans. N.Z. Inst., vol. iii., p. 278), at White Island (Geol. Rep., 1873-74, pp. xii. and xviii.) in the sulphur sands of Amuri Bluff and the

black shales of the Awanui series at Poverty Bay; Mr. Skey (Geol. Rep., 1870-71, p. 88) mentions its occurrence at the Thames; Dr. v. Haast (Geol. Rep., 1873-74, p. 18) as crystals in dark greyish sands at Lake Heron; and Mr. McKay (Geol. Rep., 1880-81), at Waihao River, Canterbury.

Professor Liversidge (Trans. N.Z. Inst., vol. x., p. 493) has described some rough crystals from Moeraki and Awamoko, and thin, columnar, opaque white crystals, sometimes interlacing and somewhat fibrous, from White Island, as well as a white opaque mammillated encrusting mass from a cave at Mr. Nicholas', Lake Wakatipu.

Besides these, specimens have been forwarded for identification from the Malvern Hills by Mr. H. H. de Bourbel, from the Kaitoki Ranges, New Plymouth, by Mr. Robert Hughes, and the Thames by Mr. McDonald. The specimens in the Colonial Museum are chiefly from White Island (from which locality a very beautiful collection has been made by Dr. Hector), and from Waihao, Canterbury.

Dr. Hector has described those from White Island as follows (Trans. N.Z. Inst., vol. iii., p. 284):—"The specimens obtained from the edge of the lake are chiefly masses of sulphate of lime, sometimes in the form of massive gypsum, but more frequently crystallized in the form of oblique prisms of selenite. The faces of these crystals are frequently coated with crystalline films of pure sulphur."

The specimens from Waihao are transparent crystals of selenite roughly crystallized and imbedded in clay-shale.

They occur chiefly as crystals, consisting of the prism $\infty P.$, the clinopinacoid $\infty P^c\infty$, and the hemipyramid $-P$; and they are frequently macled, along a face parallel to the orthodiagonal, to form rough arrow-head crystals, sometimes of considerable size. They are sometimes arranged in stellate groups.

A specimen has also been collected from Tohatapu, in the Otamatea arm of Kaipara Harbour, where it occurs as opaque white plates imbedded in a sandy marl.

Apatite, $3\ \dot{C}a^3\ \dddot{P} + Ca\ (Cl, F)$.—This mineral is mentioned by R. Daintree, Esq., F.G.S. (Trans. N.Z. Inst., vol. vii., p. 459), as slender acicular crystals occurring in dolerite from the Hororata district, and as long prisms in dolerite from the Acheron section.

SALTS OF MAGNESIA.

Magnesite, $\dot{M}g\ \ddot{C}$.—A soft, white, earthy variety of this mineral is in the collection of the geological survey from Rotorua, and a nearly pure, white, massive form has also been collected by Mr. S. P. Smith from the Chatham Islands. In 1878 I collected a crystallized specimen from Collingwood, in which the rhombohedral cleavage is very perfect, colour white, lustre pearly.

Dolomite, $\dot{\text{Ca}}\,\ddot{\text{C}} + \dot{\text{Mg}}\,\ddot{\text{C}}$.—Dr. v. Haast mentions the occurrence of this mineral at the Malvern Hills (Jurors' Rep. N.Z. Ex., 1865, p. 256) interstratified with augitic greenstone, and it was collected by Dr. Hector in 1872 from Collingwood.

Pearlspar.—A specimen of this mineral was collected by Dr. Hector in 1878, from the Big Pump Shaft at the Thames.

Epsom-salt, $\dot{\text{Mg}}\,\dddot{\text{S}} + 7\,\dot{\text{H}}$.—Dr. Hector mentions the occurrence of this mineral on Murison's station in Otago (Jurors' Rep. N.Z. Ex., 1865, p. 438).

Salts of Alumina.

Taranakite.—This mineral, which is a double hydrous phosphate of alumina and potash, part of the alumina being replaced by ferric oxide, was first discovered by H. Richmond, Esq., at the Sugar Loaves, Taranaki, where it occurs as thin seams which occupy fissures in the trachytic rocks. It is described by Dr. Hector (Juror's Rep. N.Z. Ex., 1865, p. 423) as of a yellowish-white colour; amorphous and soft; readily fusible before the blowpipe, and in other respects resembling wavellite. It has the following composition:—

Phosphoric acid		35·05
Alumina		21·43
Ferrous oxide		4·45
Lime		·55
Potash		4·20
Soda		traces
Chlorine		·46
Sulphuric acid		traces
Insoluble in acid (silica)		·80
Water driven off at 212° ..	15·46	33·06
,, ,, ,, red heat	17·60	
		100·00

and has a slight acid reaction.

Wavellite, $\dddot{\text{Al}}^3\,\dddot{\text{P}}^2 + 12\,\dot{\text{H}}$.—Occurs as thin seams of a dark, yellowish-brown colour, hard, translucent, and infusible, traversing the taranakite in various directions, and is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex. 1865, p. 424).

Alunogene, $\dddot{\text{Al}}\,\dddot{\text{S}}^3 + 18\,\dot{\text{H}}$, is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 438) as occurring in some of the brown coals. In 1867 a specimen was forwarded from Tuapeka by Dr. Halley, which proved to be nearly pure sulphate of alumina. It was colourless and well crystallized and completely soluble in water. The following analysis shows that its composition is—

Sulphate of alumina, with traces of sulphate of lime ..	55·60
Sulphate of lime	1·01
,, magnesia	2·99
Alkaline sulphates	3·00
Water	37·40
	100·00

In 1868 a specimen, also consisting chiefly of sulphate of alumina, was forwarded for identification by Mr. G. Richardson from Rancowers Island, Manawatu.

Alum, $\dot{R}\dddot{S} + (\ddot{\overline{Al}}, \ddot{\overline{Fe}})\dddot{S}^3 + 24\dot{H}$.—The first mention of the occurrence of this mineral in New Zealand is by Dr. v. Hochstetter (New Zealand, 1863, Eng. ed., p. 408), who states that on Puai Island, in the Rotomahana Lake, he found films of fibrous alum under cakes of siliceous deposit.

Dr. Hector mentions its occurrence as a product of decomposition of pyritous shale at Waikouaiti (Jurors' Rep. N.Z. Ex., 1865, p. 35), and (p. 421) he states that aluminous shale is generally associated with the brown coal formation. An analysis of some shale that had undergone natural decomposition, and was covered with an efflorescence of alum, gave—

Sulphate of alumina..	11·80
,, ,, protoxide of iron ..	5·27
,, ,, sesquioxide of iron ..	traces
,, ,, lime	1·31
,, ,, soda and potash ..	14·60
Chlorides	traces
Insoluble in water	33·30
Water and loss	33·72
	100·00

the insoluble matter being principally angular fragments of schist. He also mentions (Jurors' Rep. N.Z. Ex., 1865, p. 438) the occurrence of potash alum in shale at Tokomairiro, and the Auckland Local Committee exhibited specimens of alum from Rotomahana.

In 1866 Mr. T. R. Hacket collected some magnesian alum from D'Urville Island, where it is found as delicate acicular crystals, of a pure white colour, grouped in large botryoidal masses, the exterior surfaces of which are of a yellowish colour from the presence of basic sulphate of iron. It has a sour and slightly astringent taste, is very soluble in water and intumesces on the application of a gentle heat. In the blowpipe flame after desiccation it is infusible ; displays considerable incandescence and yields the reaction of soda. Its composition is—

Alumina	10·40
Ferric oxide	1·11
Lime	·50
Magnesia	5·46
Soda	·41
Sulphuric acid	37·40
Hydrochloric acid	traces
Water	42·72
Insoluble in water	2·00
	100·00

Non-Metallic Minerals.—Class V.

Earths (Silica and Alumina).

Silica.

Quartz, $\ddot{S}i$.—The distribution of this mineral in New Zealand in one form or the other is general.

Rock Crystal.—The purest form of quartz is represented in the collection of the Colonial Museum by a clear pellucid specimen from Tamata, and some beautiful little crystals from Kereru, Napier, which were forwarded on the supposition that they were diamonds. These small rock crystals occur in many localities in the North Island, being derived from the rhyolitic rocks, which occupy a considerable area in the Taupo district; and they are again found in Canterbury, where they enter into the composition of the quartz porphyries of Mt. Somers and the Clent Hills; they have frequently been forwarded for examination from time to time on the supposition that they were diamonds. Some very beautiful specimens of rock crystal were collected from the Cromwell Company's Mine last year by Mr. McKay, the crystals being sometimes three-quarters of an inch long and a sixteenth of an inch in diameter, the ends being sometimes pyramidal, sometimes hemihedral, and sometimes tetrahedral; they frequently interpenetrate one another, and two groups of crystals interpenetrate and pass through very flat and perfectly crystallized rhombohedrons of calcite. Some fine specimens from Milford Sound are also in the collection.

Amethyst Quartz.—Some very fine specimens from the Rakaia Gorge, Canterbury, are in the collection of the Colonial Museum, and Dr. v. Haast mentions its occurrence in amygdaloidal trap (Jurors' Rep. N.Z. Ex., 1865, p. 256) and in the melaphyres of Canterbury (Geol. Rep. 1873-74, p. 9).

Milky Quartz.—Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 256) mentions it in the granites of the West Coast, and it is of common occurrence throughout New Zealand.

Prase is mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 256) as small deposits in quartzose porphyritic trachytes at the Gawler Downs.

Jasper.—There is in the collection of the Colonial Museum a specimen from Tinker's Gully, Thames, which is red but gritty, one from Hongikuri, Auckland, also red but gritty, and another from Mahurangi, which is red, with opaline and brown patches. Besides these Dr. Hector has mentioned its occurrence at the Snares (Trans. N.Z. Inst., vol. ii., p. 177), in the volcanic rocks of Moeraki and Otepopo, and the porphyritic rocks of Dunedin Harbour (Jurors' Rep. N.Z. Ex., 1865, pp. 266 and 437), and at Coromandel and Whangaparawa (Jurors' Rep. N.Z. Ex., 1865, p. 253); it is mentioned by Dr. v. Haast from the Malvern Hills (Jurors' Rep. N.Z.

Ex., 1865, p. 256), and as porcelain jasper from Petrifying Gully, Mount Somers (Geol. Rep., 1873-74, pp. 9, 10); by Dr. v. Hochstetter in the tuffs and conglomerates of Coromandel (New Zealand, 1863, Eng. ed., p. 96); by Mr. J. C. Crawford, at Ruamahunga (Trans. N.Z. Inst., vol. ii., p. 345), and by Prof. Liversidge at Clutha, and as green jasper at Moeraki (Trans. N.Z. Inst., vol. x., p. 496). He describes the specimen from Moeraki as follows:—" Variegated with reddish brown streaks; a little chalcedony on one surface. The green colour is mainly due to the presence of protoxide of iron; there is also manganese present in small quantity. On heating in a closed tube it decrepitates slightly, blackens and gives off water having an alkaline reaction; there is a slight empyreumatic odour evolved." Mr. Buchanan has also mentioned the occurrence of green jasper at the Awatere River (Geol. Rep., 1866-67, p. 35), and Captain Hutton alludes to it near Hongikuri on the Cape Colville Peninsula, where rounded blocks of diorite are encased with a coating of red jasper (Geol. Rep., 1867, p. 8).

Lydian Stone.—A specimen of grey flinty slate from Whangarei is in the collection of the Colonial Museum, and lydian stone is also mentioned by Dr. v. Haast, at the Malvern Hills. (Jurors' Rep. N.Z. Ex., 1865, p. 256.)

Chert and Quartzite are of very frequent occurrence in our metamorphic rocks and silurian beds; they occur as thick beds in the Lower Devonian formation, where they are fossiliferous; are met with again in the Lower Carboniferous and Upper Devonian series; and again in many of the Lower Secondary and Jurassic rocks, where they sometimes occur as fossiliferous beds.

Flint occurs in chalk at Oamaru, in chalk marls at the Kaipara and Bay of Islands, and as black and grey masses in Petrifying Gully, Mt. Somers, where also iron flint of a red and brown colour is found. It is mentioned by Dr. Hector in chalk on Campbell Island (Trans. N.Z. Inst., vol. ii., p. 178), and by Dr. v. Haast as filling cavities in the rocks of Canterbury (Jurors' Rep. N.Z. Ex., 1865, p. 256), and in the limestone of Amuri Bluff, (Geol. Rep., 1870-71, p. 38), and Prof. Liversidge (Trans. N.Z. Inst., vol. x., p. 495) mentions its occurrence at Tapanui, Otago, and Whangarei Heads, Auckland.

Chalcedony.—This mineral has chiefly been found in geodes in the melaphyres and quartz-porphyries of Canterbury, but the specimens are chiefly of an inferior class. They are green, grey, brown, and white, and are sometimes arranged in parallel bands passing into *agate* or *onyx*. In the collection of the Colonial Museum, there are specimens from Clent Hills, Gawler Downs, Mt. Somers, and Tokatoka on the Wairoa River. It is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437) in the volcanic rocks of Moeraki and Otepopo; by Dr. v. Haast (Jurors'

Rep. N.Z. Ex., 1865, p. 256) in mammillated and botryoidal forms in amygdaloidal traps and quartzose trachytes, Canterbury; and by Dr. v. Hochstetter (New Zealand, 1863, Eng. ed., p. 96) in the tuffs and conglomerates of Coromandel; *agates* being mentioned from the same localities and *onyx* by Dr. v. Haast from the Malvern Hills, Clent Hills, Mt. Somers, etc. Prof. Liversidge (Trans. N.Z. Inst., vol. x., p. 494) mentions the occurrence of chalcedony at Moeraki and Otepopo, and agate at Mt. Charles, Otago.

Carnelian is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437) in the volcanic rocks at Moeraki and Otepopo, and the porphyritic rocks of Dunedin Harbour; by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 256) in small geodes in the volcanic rocks of Canterbury; and by Dr. v. Hochstetter (New Zealand, 1863, Eng. ed., p. 96) in the tuffs and conglomerates of Coromandel; and Professor Liversidge (Trans. N.Z. Inst., vol. x., p. 495) describes two inferior specimens from Coromandel.

Plasma.—There are four specimens of this mineral in the collection of the Colonial Museum from Mt. Somers and Gawler Downs. They are of a pale to dark leek green and waxy lustre. It is also mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 266) in the volcanic rocks of Moeraki and Otepopo; and by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 256), filling fissures in tertiary quartzose trachyte at Gawler Downs.

Chrysoprase is mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 256) filling cavities in amygdaloidal rocks in Canterbury.

Bloodstone.—There is one inferior specimen in the collection of the Colonial Museum from Clent Hills. It is of a deep green colour with small red spots. Dr. v. Haast mentions its occurrence in small pieces at Snowy Peak and Malvern Hills.

Quartz as Pseudomorphs of Calcite.—There is a specimen of quartz from the Malvern Hills in the collection of the Colonial Museum forming hollow pseudomorphs of rhombohedral crystals of calcite, some of the calcareous crystals being still preserved, and Dr. Haast also mentions the occurrence of a similar mineral at Rakaia Gorge and Clent Hills (Jurors' Rep. N.Z. Ex., 1865, p. 256.)

Quartz Sands.—Heavy deposits of quartz sand in various degrees of purity occur associated with the lower beds of the cretaceo-tertiary formation at Mt. Somers, Limestone Bluff on the Ashburton River, Lake Heron and Waipara, as mentioned by Dr. v. Haast (Geol. Rep., 1870-71, p. 11; and 1873-74, p. 17.)

Tridymite, $\dot{S}i$.—Small hexagonal plates of tridymite occur in the trachytic rocks of Lyttelton Harbour, and were first recognized by Professor Ulrich in specimens collected by Dr. v. Haast.

Opal, $\ddot{Si}$, $\dot{H}$, or $\ddot{Si}\,\dot{H}^3$.—The more valuable varieties are not known in New Zealand, but the inferior qualities are of common occurrence.

Hyalite is mentioned by Dr. v. Haast as occurring in small masses, lining cavities in the volcanic rocks of Snowy Peak and the Malvern Hills (Jurors' Rep. N.Z. Ex., 1865, p, 256), and again in a few localities in the volcanic rocks of Banks Peninsula (Trans. N.Z. Inst., vol. xi., p. 511), and is also mentioned by Professor Liversidge (Trans. N.Z. Inst., vol. x., p. 496) lining cavities in the vesicular grey trachytes of Bell Hill, Dunedin.

Common Opal and Semi-opal are mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 256) as filling small cavities in the quartz porphyries of the Malvern Hills and Mt. Somers, and last year I obtained from the drift of Owharoa a specimen which is of a pure milky-white colour.

Wood Opal (*Silicified Wood*) is very common where siliceous rocks are decomposing as at Petrifying Gully, Mount Somers. It is mentioned by Dr. v. Hochstetter (New Zealand 1863, Eng. ed., p. 96) in the tuffs and conglomerates of Coromandel, and by Dr. Haast (Juror's Rep. N.Z. Ex., 1865, p. 256) from many localities in Canterbury.

Pitch Opal.—A specimen from Dunstan is described by Prof. Liversidge (Trans. N.Z. Inst., vol. x., p. 496) as follows:—"Brown, variegated, light and dark shades. Hardness about 6. When heated in closed tube gives off water, blackens, and emits empyreumatic odour; the condensed water has an acid reaction, and on evaporation leaves a carbonaceous residue which blackens on ignition; breaks with a well-marked conchoidal fracture; contains iron." There are two specimens of this mineral in the collection of the Colonial Museum—one from the Harper Hills, and the other from the Rakaia Gorge.

Opal-jasper.—There is in the collection of the Colonial Museum a specimen of opaline quartz with jasper, from the trachyte tufa of Portobello, Otago, which forms a very pretty ornamental stone. The predominating colours as described by Prof. Liversidge (Trans. N.Z. Inst., vol. x., p. 496) are red-brown, blue-grey, and opal-white.

Siliceous Sinter.—Deposits of this class are found surrounding several of the thermal springs, and have been well described by Dr. v. Hochstetter (New Zealand, 1863, Eng. ed., pp. 398, 412). He says, in speaking of the siliceous deposits of Orakeikorako: "The sediment of this, like all the surrounding streams, is siliceous; the recent sediment is soft as gelatine, gradually hardening into a triturable mass, sandy to the touch, and finally forming, by the layers deposited one above the other, a solid mass of rock of very variable description at different places both as to colour and structure. Here it is a radiated fibrous or stalky mass of light brown colour; there a chalcedony hard as steel, or a grey flint; at other places the deposit

is white, with glossy conchoidal fracture like milk-opal, or with earthy fracture like magnesite. At Te Tarata siliceous deposits in terraces cover about three acres of land.

Alumina.

Corundum, $\overset{\cdots}{\bar{Al}}$.—Dr. v. Haast mentions the occurrence of the variety sapphire from the western slopes of the Southern Alps (Geol. Rep., 1870-71, p. 24), and in August, 1871, Captain Hutton brought another specimen from Collingwood, which is now in the Colonial Museum. It is described in the Seventh Museum and Laboratory Report, p. 18, as follows :—" A rough sapphire, sent by a digger, who found it with alluvial gold at Collingwood, Nelson, is the first discovery of this precious stone in the colony. The specimen, which weighs 336·9 grains, is in the form of a water-worn pebble, remarkable on account of its deep blue colour on the fractured surface, and its great weight; but it is so traversed by fissures as to be of no value as a gem. Its specific gravity is 3·869."

Non-metallic Minerals.—Class VI.

Silicates and Aluminates.
- Silicates of magnesia and lime, hydrous and anhydrous.
- Silicates of alumina, hydrous and anhydrous.
- Aluminates of magnesia and glucina.
- Silicates of glucina, zirconia, thoria, and yttria.

Anhydrous Silicates of Magnesia and Lime.

Wollastonite, $\dot{Ca}\ \ddot{Si}$.—Specimens of a massive form of wollastonite were collected from the Dun Mountain by the late Mr. E. H. Davis in 1871, and are now in the collection of the Colonial Museum. They have been described and analyzed by Mr. Skey, who reports (Col. Mus. & Lab. Rep. vi., p. 15) that the four specimens examined had the following composition :—

	1.	2.	3.	4.
Silica	48·01	49·30	50·62	58·80
Lime	46·20	45·91	44·88	24·60
Magnesia	traces	·80	traces	1·60
Alumina	1·45	1·41	1·84	} 12·20
Iron oxide	traces	traces	1·64	
Loss	2·19	1·19	traces	1·40
Water	2·15	1·39	1·02	1·40
	100·00	100·00	100·00	100·00

The iron oxide in Nos. 3 and 4 is the protoxide, and No. 4 contains traces of chromium.

They are massive, confusedly crystalline, colour pure white, lustre pearly inclining to vitreous on certain fractures, easily fusible to glassy bead with no soda reaction. Easily decomposed by hydrochloric acid with the formation of gelatinous silica; hardness 4 to 5. No. 4 is an impure

wollastonite passing into scapolite by substitution of alumina for lime. It is a green-coloured mineral, quite amorphous, and occurs coating one side of a tough light green rock, probably jade.

Chrysolite (*Olivine*), $(\dot{\mathrm{Mg}}, \dot{\mathrm{Fe}})^2 \ddot{\mathrm{Si}}$.—The first mention of the occurrence of this mineral in New Zealand is by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 413, and 437), who states that it is of frequent occurrence in the basaltic rocks of Saddle Hill and elsewhere, and also occurs in Milford Sound. It is again mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 257) as grains in the basaltic rocks of Banks Peninsula, and (Trans. N.Z. Inst., vol. i., p. 180) as large concretions in basaltic rocks from the Chatham Islands, and (Geol. Rep., 1870-71, p. 29) in the basalts of the Hurunui and Mandamus districts. R. Daintree, Esq., F.G.S., refers to its occurrence in dolerites from the Selwyn River, Snowy Peak Range, Flagstaff Hill basin, and Hororata district, (Trans. N.Z. Inst., vol. vii., p. 458); Professor Liversidge also describes a specimen from Dunedin as brown-coloured imbedded grains (Trans. N.Z. Inst., vol. x., p. 497), and I have noticed small grains of this mineral, green and brown in colour, in many microscopic sections of basaltic and doleritic rocks from various localities.

Dunite.—This mineral is a massive variety of olivine through which grains of chromite are scattered. A specimen from the Dun Mountain, Nelson, was first described by Dr. v. Hochstetter (New Zealand, 1863, Eng. ed., p. 474) as follows:—"It consists of a very peculiar kind of rock, of a yellowish-green colour when recently broken, but turning a rusty brown on the surface when decomposing. The mass of the rock is olivine, containing fine black grains of chromate of iron interspersed; it is distinguished from serpentine, for which it was formerly taken, especially by its greater hardness and its crystalline structure. I have called it Dunite." Analysis of dunite by R. Reuter (Lab. of the Polyt. Inst. of Vienna):—

Silica	42·80	
Magnesia	47·38	
Protoxide of iron ..	9·40	
Water	·57	Sp. gr. .. 3·30
	100·15	

It is again mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 411), who adds to Dr. v. Hochstetter's description, that it possesses a flaky structure, conchoidal fracture and hardness of 6; and he also mentions its occurrence at Milford Sound, where it passes into jade. He again alludes to it (Trans. N.Z. Inst., vol. ii., p. 377), stating that at the Dun Mountain it appears at the surface as a large mass several miles in extent. It has since been discovered at Jackson's Bay, by Mr. D. Macfarlane, associated with serpentinous rocks (Geol. Rep., 1876-77, p. 27).

Augite, $\dot{R}\,\ddot{Si} = (\dot{Ca}, \dot{Mg}, \dot{Fe})\,\ddot{Si}$.—This mineral enters into the composition of all our basalts, dolerites, anamesites, trachydolerites, diabases, and melaphyres. Isolated crystals are rare, but there is a specimen in the collection of the Colonial Museum, of porphyritic diabase from Nelson, in which dark-green monoclinic crystals of augite are well developed, some of them being half an inch long. No macles are seen in this specimen.

It is mentioned by Dr. Hector in the basalts around Dunedin (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 438), in basalt from the Snares, and in dolerite from Antipodes Island (Trans. N.Z. Inst., vol. ii., p. 179), and in the dolerites and basalts of the Auckland Islands (Trans. N.Z. Inst., vol. ii., p. 183); by Dr. v. Haast in trachydolerites and as fine twin crystals imbedded in agglomeratic tufa, Banks Peninsula (Jurors' Rep. N.Z. Ex., 1865, p. 257), in concretions in basaltic rocks of Chatham Islands (Trans. N.Z. Inst., vol. i., p. 180), and in basalts of Banks Peninsula (Trans. N.Z. Inst., vol. xi., p. 499); and by R. Daintree, Esq., F.G.S., in dolerite from the Selwyn River, Snowy Peak Range, Hororata District, Flagstaff Hill basin and Acheron section.

Asbestos.—The occurrence of this mineral at Milford Sound is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 266), and the late Mr. E. H. Davis records it from Dun Mountain (Geol. Rep., 1870-71, p. 112). There are several specimens in the collection of the Colonial Museum, but none of them possess that flexibility and readiness to separate into fibres without which the mineral is of but little value. The best sample was collected from Collingwood by Dr. Hector; it is of a pale green colour and fibrous. It occurs associated with the steatites there.

Tachylite, $\dddot{Al}\,\ddot{Si}^2 + 3\,(\dot{Fe}, \dot{Ca}, \dot{Mg}, \dot{Mn}, \dot{Na}, \dot{K})\,\ddot{Si}$.—The occurrence of this mineral on the sides of fissures in the volcanic rocks of Banks Peninsula, where trachytic dykes have intruded, is mentioned by Dr. v. Haast (Trans. N.Z. Inst., vol. xi., p. 503).

Hornblende, $\dot{R}\,\ddot{Si}$.—Is of very common occurrence in New Zealand as a constituent of the syenites, trachytes and diorites which abound, and also in certain hornblendic schists and gneiss which are met with in the north-western part of the South Island, and again at the Bluff, Southland. It is mentioned by Dr. v. Hochstetter (New Zealand, 1863, Eng. ed., p. 471) as a blackish-green hornblende in the syenite of the boulder-bank, Nelson; by Dr. Hector as veins in syenitic and older trap-rocks in Milford Sound (Jurors' Rep. N.Z. Ex., 1865, pp. 267, 438), in the trachyte of the Sugar Loaves, Taranaki (Geol. Rep., 1866-67, p. 8), as a hornblende rock in the Auckland Islands and Ruapuke (Trans. N. Z. Inst., vol. ii., pp. 183, 185), and in diorite on Great Barrier Island (Trans. N.Z. Inst., vol. ii., p. 375); by Dr. v. Haast, in basaltic and doleritic rocks at Banks Peninsula, Malvern

Hills, Timaru, etc., (Jurors' Rep. N.Z. Ex., 1865, p. 257, and Trans. N.Z. Inst., vol. xi., p. 499), probably only in very small quantities as an accessory mineral, or the rocks would necessarily become andesites, and as large concretions in basaltic rocks of the Chatham Islands (Trans. N.Z. Inst., vol. i., p. 180); by Mr. Buchanan, as fine specimens with serpentine from the Awatere River (Geol. Rep., 1866-67, p. 35); by Mr. E. H. Davis, at Dun Mountain (Geol. Rep., 1870-71, p. 112); and by Prof. Liversidge, at Lake McKerrow, West Coast, Kakanui Mountains, Dun Mountain, and Dunedin (Trans. N.Z. Inst., vol. x., p. 496), besides which there are some fine specimens in the collection of the Colonial Museum from syenitic gneiss of the Baton River, Nelson.

Tremolite.—Some beautiful dendritic groups of tremolite, in quartzite, from Kanieri, Hokitika, of a dark green colour, are in the collection of the Colonial Museum, as well as some fine greenish-white radiating crystals from Parapara, Collingwood, and some bright green radiating crystals from the same locality. The occurrence of the mineral in Milford Sound is also mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 267, 438).

Actinolite.—The occurrence of this mineral in New Zealand is noted by Dr. v. Haast in metamorphic schists of the West Coast (Jurors' Rep. N.Z. Ex., 1865, p. 257); by Mr. Buchanan in the Awatere River (Geol. Rep., 1866-67, p. 35); and by myself as radiating fan-shaped crystals in the river-beds of the West Coast south of Mt. Cook, where they are much decomposed (Geol. Rep., 1874–76, p. 73).

Anthophyllite.—Specimens of this mineral have been collected from the Dun Mountain from time to time, the first specimens having been brought by Mr. E. H. Davis in 1871. It occurs in a massive laminated form of a leek-green colour, with a pearly lustre and a faint bronze hue on the cleavage planes.

Nephrite, $\dot{R}\ \ddot{Si}$.—The occurrence of this mineral, commonly known as "Maori greenstone," is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 412, 437) * from Milford Sound, and also as a single rolled fragment, which had probably been carried there, from Silverstream, Dunedin; by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 257) as rolled pieces on the beach of the West Coast; and by the late Mr. E. H. Davi (Geol. Rep., 1870-71, p. 112) as white nephrite from Dun Mountain. The only locality where it has been found *in situ* is at Milford Sound, where it

* The first notice of this and the other Otago minerals is to be found in Dr. Hector's reports on the geology of Otago, published in the Provincial Government Gazette for 1862-64, but these being now difficult of access, the reference (Jurors' Rep. N.Z. Ex., 1865) has been adopted throughout this paper, as in that publication Dr. Hector included a list of all minerals which had been noted in his reports up to that date.

occurs as veins traversing serpentine and hornblende schist, one variety being speckled with chromic iron. It is found as boulders, sometimes of great size, in the auriferous wash of a few localities on the West Coast, such as the Kumara diggings, on the banks of the Teremakau River, and the Greenstone diggings near Lake Brunner. Two analyses of this mineral, quoted by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 413) give the following composition :—

Silica	51·08	56·00
Protoxide of iron, with traces of manganese and chromium	12·43	11·13 (Protoxide of iron and Alumina together)
Alumina	1·42	
Lime	9·00	9·94
Magnesia	21·35	21·96
Soda	traces	traces
Water of constitution	·97	·97
	96·25	100·00

Diallage, $(\dot{C}a, \dot{M}g, \dot{F}e)\ddot{S}i$.—The first mention of this mineral in New Zealand is by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 438) as occurring in diorites on the West Coast, and during his trip round the West Coast Sounds in 1863, he collected specimens in gabbro from Hokuri Creek, Martin's Bay, Lake McKerrow, and the head of Kakapo Lake ; he again mentions it (Trans. N.Z. Inst., vol. ii., p. 377) as dykes in the Dun Mountain. It is mentioned by Dr. v. Haast as occurring in gabbro in the Mt. Torlesse Range and Upper Rakaia (Jurors' Rep. N.Z. Ex., 1865, p. 257) ; by Mr. J. C. Crawford in reefs traversing mesozoic limestones at Waikekino (Trans. N.Z. Inst., vol. ii., p. 351) ; by Mr. E. H. Davis, at the Dun Mountain (Geol. Rep., 1870-71, p. 112) ; and again by Prof. Liversidge in his description of the minerals in the Otago Museum (Trans. N.Z. Inst., vol. x., p. 496), from Lake McKerrow and Dun Mountain. There is a specimen in the collection of the Colonial Museum, from Kakapo Lake, of a dark-green colour and metallic lustre, which is not well marked, corresponding with the specimen described by Prof. Liversidge from Lake McKerrow.

Hypersthene, $(\dot{M}g, \dot{F}e)\ddot{S}i$.—This mineral is mentioned by Dr. Hector in diorite rocks on the West Coast (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 438), and was collected by him from Warp Point, Kaduku River, in 1863. It is again mentioned by Dr. v. Haast in hypersthenite, Malvern Hills (Jurors' Rep. N.Z. Ex., 1865, p. 257) ; by Mr. E. H. Davis at the Dun Mountain (Geol. Rep., 1870-71, p. 112) ; and by Prof. Liversidge as occurring in the collection of the Otago Museum from Warp Point, Kaduku River (Trans. N.Z. Inst., vol. x., p. 497).

It has been collected from Red Hill, Collingwood, by Dr. Hector (Col. Mus. & Lab. Rep., xiii., p. 35).

Bronzite, $\dot{Mg}$ ($\dot{Fe}$) Si.—The occurrence of this mineral in diorite rocks of the West Coast is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 438), and by Mr. E. H. Davis at the Dun Mountain (Geol. Rep. 1870-71, p. 112). A specimen from the Dun Mountain in the collection of the Colonial Museum consists of crystals of a brownish-green colour imbedded in a network of veins of picrosmine.

Hydrous Silicates of Magnesia and Lime.

Meerschaum, 2 $\dot{Mg}^2$ $\ddot{Si}^3$ + 3 $\dot{H}$.—The occurrence of this mineral at the Dun Mountain is mentioned (Col. Mus. & Lab. Rep., vi., p. 16), the specimen having been collected by the late Mr. E. H. Davis. "Its colour was pure white, lustre feeble, opaque, structure amorphous; to the touch it has that soft smoothness peculiar to minerals of this class; hardness 2 to 3; easily decomposed by hydrochloric acid. It occurs in contact with massive white quartz, enclosing columnar detached crystals of a dark green colour, probably hypersthene." Its composition is—

Silica	53·76
Lime	2·36
Alumina	4·35
Iron oxides	traces
Magnesia	20·36
Water of constitution	19·17
	100·00

Dermatin, ($\dot{Mg}$, $\dot{Fe}$) $\ddot{Si}$ + 2 $\dot{H}$.—This mineral is mentioned by Mr. E. H. Davis (Geol. Rep., 1870-71, p. 112) as occurring in thin faces with smooth polished surfaces at the Dun Mountain.

Talc, $\dot{Mg}^3$ $\ddot{Si}^4$ + $\dot{H}$.—The occurrence of this mineral is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 438) in quartz from the West Coast Sounds; and again by Mr. D. Macfarlane (Geol. Rep., 1876-77, p. 27) at Jackson's Bay. There are specimens in the collection of the Colonial Museum from Collingwood and Jackson's Bay, both being of a pale green colour. It is somewhat widely distributed on the West Coast of the South Island, being frequently found associated with the crystalline rocks of that district.

Steatite is mentioned by Dr. Hector at Milford Sound (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437), and it occurs in considerable quantities at Collingwood in a massive form and of a grey pink and green colour; some specimens are foliated. Its position is shown on the geological map of Collingwood published by Dr. Hector (Geol. Rep., 1873-74, p. iv.)

Serpentine, $\dot{Mg}^3 \ddot{Si}^2 + 2 \dot{H}$.—This mineral is somewhat widely distributed in New Zealand, occupying as a rule the junction line or thereabouts between the Lower Carboniferous and Upper Devonian rocks, but it is also found associated with nephrite at Milford Sound. Dr. Hector says (Jurors' Rep. N.Z. Ex., 1865, p. 412):—"This mineral occurs in New Zealand in two forms—*Common Serpentine*, that forms extensive rock-masses characteristic of the mineral ground in various parts of the South Island in the provinces of both Nelson and Otago; and *Noble Serpentine*, which occurs in thin veins associated with the jade or greenstone of the Maoris, by whom it is distinguished by the name of Tangiwai."

The principal development of the common serpentine is in Nelson, where what is known as the mineral belt may be traced down D'Urville Island through the Dun Mountain to Aniseed Valley, an isolated patch occurring again at Red Hill. It is alluded to by several observers, such as Dr. v. Hochstetter, Dr. Hector, Mr. E. H. Davis, Mr. A. McKay, and myself, in reports made from time to time on various parts of the district, and is described by Mr. E. H. Davis (Geol. Rep., 1870-71, p. 111) thus:—"Dun Mountain serpentine as a rule is of a poor variety, generally a dark green, almost black colour, appearing lighter by transmitted light: translucent at the edges and rather brittle."

It is mentioned by Mr. J. C. Crawford as occurring in small quantities in the palæozoic rocks of Wellington (Trans. N.Z. Inst., vol. i., p. 4), and again at Ruamahunga (Trans. N.Z. Inst. vol. ii., p. 345); by Dr. v. Haast as veins in the Mt. Cook range and some other localities in the Southern Alps (Jurors' Rep. N.Z. Ex., 1865, p. 257); by Mr. J. Buchanan in the Awatere River, Marlborough (Geol. Rep., 1866-67, p. 35) and by Mr. D. Macfarlane at Jackson's Bay (Geol. Rep., 1876-77, p. 27). Specimens have also been forwarded to the Colonial Museum from Island Bay, Wellington, by Mr. W. F. Barraud; from Southland (Windly Creek) by Captain Hutton; from Auckland by Mr. J. B. Gillies; from Pelorus Sound by Mr. Duncan; and from the Dart River by the Hon. Captain Fraser.

Noble serpentine, as before mentioned, occurs at Milford Sound, and is described by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 412) as follows:—"It occurs as boulders of various sizes, and generally much water-worn. Some of the smaller pieces when cut and polished are very attractive on account of their beautiful deep sea-green colour, their translucency, their purity, and remarkable closeness of grain. This mineral is somewhat soft, and, breaking readily, is capable of being worked into any shape with the greatest ease, and for ornamental work generally is well adapted. Its general characters are as follow: Colour, dull green and mottled black lustre, slightly resinous; fracture, splintery; streak, dirty white; hardness

4·5; sp. gr. 2·592. Is completely decomposed by hydrochloric acid. In blowpipe flame infusible, turns faint buff colour, no distinct soda reaction, but slight reaction of manganese with the proper fluxes."

Analysis.

	1.	2.	3.
Silica..	40·20	41·20	45·91
Protoxide of iron	12·10	12·10	1·67
Alumina	traces	traces	5·63
Manganese	"	"	traces
Chromium	"	"	"
Magnesia	33·20	34·02	35·07
Water of constitution	12·70	12·74	12·67
	98·20	100·06	100·95

This is alluded to by Prof. Liversidge (Trans. N.Z. Inst., vol. x., p. 497) as marmolite.

There is also a specimen in the collection of the Colonial Museum, from Jackson's Bay, which is of a grass-green colour, translucent and laminated.

Antigorite.—The occurrence of this mineral at the Dun Mountain is mentioned by the late Mr. E. H. Davis (Geol. Rep., 1870-71, p. 112).

Hectorite occurs at the Dun Mountain, Nelson (for description see below, Art. xlviii.).

Picrolite, a coarsely fibrous variety, of dark dirty green colour, occurs at the Dun Mountain.

Chrysotile occurs as thin veins of a silky texture and pale green colour traversing the dark green serpentine of the Dun Mountain.

Picrosmine, $2\,\dot{Mg}\,\ddot{Si} + \dot{H}$.—A massive sectile variety of this mineral, of a greenish-grey colour, occurs associated with chromite at the Dun Mountain; it is also found as a network of veins, in which crystals of bronzite occur, in the same district.

Schiller Spar, $\dot{Mg}\,(\dot{Fe}, \dot{Ca}), \ddot{Si}\,(\dddot{Al}, \dddot{Cr}, \dddot{Fe}) + \dot{H}$.—The occurrence of this mineral with pyrites on the West Coast is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 266).

Chlorite, $2\,\dot{R}\,\ddot{Si} + \dot{R}^2\,\dddot{Al} + 3\,\dot{H}$, occurs as a constituent of the chlorite schists, which are found in many localities between Otago and Nelson on the West Coast side of the South Island. It is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437) in the schist of the West Coast, and also as an amorphous form in the vesicular basalts of Otago Heads and elsewhere; by Dr. v. Haast in laminæ in the metamorphic schists of the West Coast, (Jurors' Rep. N.Z. Ex., 1865, p. 257); by Mr. Skey, at Tararu Creek, Thames (Geol. Rep., 1870-71, p. 88); by myself in chlorite schists at the Fox Glacier, Westland (Geol. Rep., 1874–76, p. 73); and by Professor Liversidge, from Deep Creek, Kakapo Lake (Trans. N.Z. Inst., vol. x., p. 497).

Heulandite, $\dddot{\text{Al}}\,\ddot{\text{Si}}^3 + \dot{\text{Ca}}\,\ddot{\text{Si}}^3 + 5\,\dot{\text{H}}$.—The occurrence of this mineral in amygdaloidal traps associated with felsite porphyries in Canterbury, is mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 257).

Apophyllite, $8\,(\dot{\text{Ca}}\,\ddot{\text{Si}}^2 + 2\,\dot{\text{H}}) + \text{K F}$, is mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 267) occurring in amygdaloids at Rangitata, and *ichthyophthalmite* in felsite porphyries at Turnagain Point, Rangitata.

Stilbite, $\dddot{\text{Al}}\,\ddot{\text{Si}}^3 + \dot{\text{Ca}}\,\ddot{\text{Si}}^3 + 6\,\dot{\text{H}}$, is mentioned as occurring at Turnagain Point, Rangitata, by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 257). It also occurs at Tokatoka on the Wairoa River, Auckland, as radiating pearly crystals in a trachytic rock which forms Mts. Maungarahu and Tokatoka, and it is again found in a similar rock which occurs at Pukekorero, a mountain lying between the Kaiwaka arm of Kaipara Harbour and Mangawhai. Prof. Liversidge (Trans. N.Z. Inst., vol. x., p. 500) also alludes to its occurrence at Dunedin in amygdaloidal basalts as follows :—"In the cavities of these specimens are minute detached crystals of one of the zeolites. The form appears to be that of a rhombic prism capped with the pyramid; this is a combination often assumed by stilbite, and in addition the little crystals possess a very high lustre, not unlike that of stilbite; moreover, they behave like that mineral before the blowpipe, hence they probably belong to the same species.

Prehnite, $\dddot{\text{Al}}\,\ddot{\text{Si}} + 2\,\dot{\text{Ca}}\,\ddot{\text{Si}} + \dot{\text{H}}$.—This mineral is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266 and 437) as occurring in the trap rocks of Moeraki and Otepopo, and R. Daintree, Esq., F.G.S. (Trans. N.Z. Inst., vol. vii., p. 458), in speaking of a granite rock from the Snowy Peak Range, Canterbury, says:—"There is a yellowish mineral with a fibrous radial structure seen both in the specimen and the section. It is evidently a secondary formation, filling spaces between the constituents. It is probably prehnite.

Natrolite, $\dddot{\text{Al}}\,\ddot{\text{Si}}^2 + \dot{\text{Na}}\,\ddot{\text{Si}} + 2\,\dot{\text{H}}$.—The occurrence of this mineral in vesicular basalts near Dunedin is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 267 and 438), and in the volcanic rocks of Banks Peninsula, by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 257). It is also mentioned in the old catalogues of the Otago Museum as specimens from Oamaru in trachyte, from Mount Livingstone and from Look-out Point. There are numerous specimens of this mineral in the collection of the Colonial Museum, in cavities in the basalts from Dunedin. They are arranged in beautiful little tufts of fine acicular crystals, sometimes alone, and sometimes on chabasite; in other specimens they are massive but mammillated, and in others they are composed of short rhombic prisms with pyramidal ends, but these also occur in tuft-like groups. There is also a

specimen from Whakahara, on the Wairoa River, Auckland, where it occurs in a vein running through certain tufaceous beds in the Whakahara Saddle, between Maungarahu and Tokatoka. The crystals are long slender rhombic prisms, ∞P with pyramidal ends P.

Chabasite, $\dddot{\text{Al}}\ \ddot{\text{Si}}^3 + \dot{\text{Ca}}\ (\dot{\text{Na}}, \dot{\text{K}})\ \ddot{\text{Si}} + 6\ \dot{\text{H}}$, is mentioned by Dr. Hector in vesicular basalts near Dunedin (Jurors' Rep. N.Z. Ex., 1865, p. 267), and by Dr. v. Haast in the trachyte of Banks Peninsula (Jurors' Rep. N.Z. Ex., 1865, p. 257; there is also in the Catalogue of the Otago Museum a mention of a specimen from Helenburn. The specimens in the collection of the Colonial Museum are all from the first-named locality, and they consist of small rhombohedral crystals in cavities in the basaltic rocks. B.B. it deflagrates slightly and fuses to a porous enamel; colour brownish-white, no soda reaction visible.

Gmelinite, $\dddot{\text{Al}}\ \ddot{\text{Si}}^3 + \dot{\text{Na}}\ (\dot{\text{Ca}}, \dot{\text{K}})\ \ddot{\text{Si}} + 6\ \dot{\text{H}}$, is mentioned by Dr. Hector in vesicular basalts near Dunedin (Jurors' Rep. N.Z. Ex., 1865, p. 267). Specimens from this locality in the collection of the Colonial Museum are pure white, small hexagonal pyramids with OP ends. B.B. gives faint soda reaction only.

Silicates of Alumina, hydrous and anhydrous.

Kaolin, $\dddot{\text{Al}}\ \ddot{\text{Si}}^2 + 2\ \dot{\text{H}}$, is mentioned by Dr. Hector at the Manuherikia Plains and Arrow River (Jurors' Rep. N.Z. Ex., 1865, pp. 267, 438), and at the Whau, Auckland (Jurors' Rep. N.Z. Ex., 1865, p. 35); and I have mentioned its occurrence at Mt. Somers, Canterbury (Geol. Rep., 1876-77, p. 6), where it is formed by the decomposition of felsite porphyries. Specimens from drift at Collingwood have also been forwarded to the Museum.

Clay.—All the varieties of clay are found in the colony, but, for a detailed description of these with their analyses, I must refer the reader to the "Manual of the Mineral Resources of New Zealand," by Dr. Hector, in course of publication. A very fine sample of pipeclay occurs at Hakateramea, Canterbury.

Bole occurs as nests in the doleritic rocks passed through in the Lyttelton tunnel, and is associated with crystals of magnetite. Its specific gravity is 2·089, and composition as follows:—

Silica	44·78
Alumina	15·66
Iron	16·87
Manganese	·60
Lime	2·02
Magnesia	5·02
Potash	2·69
Water of constitution	12·36
	100·00

Halloysite, $\overset{\cdots}{\text{Al}}\ \ddot{\text{Si}} + 4\ \dot{\text{H}}$.—The occurrence of this mineral in decomposing basalts around Dunedin is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 438), and a specimen from the Water of Leith is described by Professor Liversidge (Trans. N.Z. Inst., vol. x., p. 499) as follows:—"An opaque white earthy substance, soft and soapy; associated with it is a little black halloysite; when immersed in water it gives off air-bubbles rapidly, accompanied by a singing sound; falls to pieces and becomes translucent on the thin edges; breaks with a conchoidal fracture; adheres strongly to the tongue; yields to the thumb-nail, and affords a shining streak; possesses an earthy smell." A sample of an impure form from Scinde Island, Napier, where it occurs in considerable quantities (Col. Mus. and Lab. Rep., vii., p. 18), was forwarded to the Museum in 1872, and had the following composition:—

Silica	58·22
Sesquioxide of iron	5·82
Alumina	24·34
Lime	2·02
Magnesia	2·53
Water	4·81
Alkalies and loss	2·26
	100·00

the high proportion of silica being due to the presence of grains of free quartz, which constitute the principal impurity. A specimen from the Bay of Islands was forwarded by Mr. J. Williamson in 1874, and is of a yellowish-brown colour, and very fine grain; three specimens from the Drury and Hunua Ranges were forwarded by the Hon. H. Chamberlin in 1875, and a specimen collected from Whangaroa Harbour, by Mr. A. McKay, during the same year.

Fuller's Earth.—Specimens from Great Barrier Island and the Hot Springs, were exhibited at the Dunedin Exhibition of 1865, by the Auckland local committee, and are mentioned (Jurors' Rep. N.Z. Ex., 1865, p. 253).

Palagonite, $(\overset{\cdots}{\text{Al}}, \overset{\cdots}{\text{Fe}})\ \ddot{\text{Si}}^3 + 3\ (\dot{\text{Ca}}, \dot{\text{Mg}}, \dot{\text{Na}})\ \ddot{\text{Si}} + 10\ \dot{\text{H}}$.—The occurrence of this mineral as angular fragments in palagonite tufas is mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 257), at Harper Hills, near the Selwyn, and at Two Brothers, Ashburton, as also another variety changing insensibly into a pitch opal, enclosing leaves and stalks silicified, in the same localities. A specimen from Taipo Hill, Otago, was forwarded in 1868 by Mr. C. Teschmaker, where it occurs as a large seam 60 feet thick, running in the direction of a limestone quarry. Its characters, as described by Mr. Skey, are—massive; colour, black; hardness, 4·5; somewhat friable; is

intersected by numerous small white veins. Readily decomposed by H. Cl. at a temperature of 212° Fah.; lost 13 per cent. water, but as it is very probable this is in greater part or altogether constitutional along with that requiring a higher temperature for its expulsion, the whole of the water present in the stone is entered in the appended analysis under one head:—

Silica	38·82
Alumina	23·17
Oxides of iron	6·30
Lime	3·65
Magnesia	3·27
Alkalies	2·03
Water	22·76
Carbonaceous matter	traces
	100·00

Schrötterite, $\dddot{\text{Al}}^2\ \ddot{\text{Si}} + 8\ \dot{\text{H}}$.—Professor Liversidge (Trans. N.Z. Inst., vol. x., p. 500) mentions a mineral from the Malvern Hills, Canterbury, which is probably schrötterite. His description is as follows:—"In rounded wax-like masses, filling the cavities of an amygdaloidal trachyte (?) rock, and has a mammillated incrustation upon its surface; green, grey, and white; hardness about 3·5; streak, white; rather tough; breaks into more or less conchoidal flakes; translucent; waxy lustre. Before the blowpipe it becomes white and opaque and much harder, intumesces slightly and tinges the flame green; affords deep blue when ignited with cobalt nitrate; does not gelatinize with hydrochloric acid, but granular silica is thrown down; gives off much water when heated in a closed tube.'

Pimelite, $2\ \dddot{\text{Al}}\ \ddot{\text{Si}} + 3\ \dot{\text{Mg}}\ \ddot{\text{Si}} + 10\ \dot{\text{H}}$.—The occurrence of this mineral filling cavities in amygdaloidal rocks, at Malvern Hills, Clent Hills, etc., is mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 257).

Idocrase (*Vesuvianite*), $3\ (\dot{\text{Ca}}, \dot{\text{Mg}})^3\ \ddot{\text{Si}} + 2\ \dddot{\text{Al}}\ \ddot{\text{Si}}^2$.—This mineral occurs as dirty green, fluted, prismatic crystals, in quartz associated with the crystalline rocks of Dusky Sound; specimens having been forwarded by Mr. W. Docherty. The larger crystals have a resinous lustre and the smaller ones, which are of a brighter green, are more pellucid.

Epidote, $2\ (\dddot{\text{Al}}, \dddot{\text{Fe}})\ \ddot{\text{Si}}^3 + 3\ \dot{\text{Ca}}\ \ddot{\text{Si}}$.—The occurrence of this mineral in gneiss granite and granulite of the West Coast is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 266) and by Dr. v. Haast in the diorites of Mt. Torlesse range (Jurors' Rep. N.Z. Ex., 1865, p. 257) and in the melaphyres of the Mt. Somers district (Geol. Rep., 1873-74, p. 9). A massive form from Wairarapa, Wellington, of a greenish-grey colour, is also in the collection of the Colonial Museum. Before the blowpipe it

fuses easily, and with intumescence to a colourless transparent bead. Easily decomposed by hydrochloric acid, with separation of gelatinous silica.

Analysis.

Silica	44·71
Iron	14·66
Alumina	11·47
Lime	22·93
Magnesia	2·13
Water of constitution	4·10
	100·00

Kyanite (*Disthene*), $\dddot{\text{Al}}\ \ddot{\text{Si}}$.—This mineral is mentioned in the Catalogue of the Colonial Museum (p. 119) from Westland. The specimen is of a beautiful cobalt blue colour, and associated with quartz. The crystals are not very distinct.

Chiastolite.—Crystals of this mineral, of a dirty-grey colour, imbedded in clay slate, from Slate River, Collingwood, are in the collection of the Colonial Museum.

Leucite, $\dddot{\text{Al}}\ \ddot{\text{Si}}^3 + \dot{\text{K}}\ \ddot{\text{Si}}$.—The occurrence of this mineral in leucitic basalt is mentioned (Col. Mus. and Lab. Rep., x., p. 18) from Castle Point, Napier, having been collected by Mr. A. McKay.

Scapolite, $\dddot{\text{Al}}^2\ \ddot{\text{Si}}^3 + (\dot{\text{Ca}}, \dot{\text{Na}})\ \ddot{\text{Si}}$.—The occurrence of this mineral in a massive form at the Dun Mountain is mentioned by Mr. E. H. Davis (Geol. Rep., 1870-71, p. 112), and an impure form of the same mineral was forwarded from the Maitai Valley, by the Nelson Museum, in 1868. The specimens collected by Mr. E. H. Davis were analyzed at the Colonial Laboratory, with the following results ;—

	(1.)	(2.)	(3.)
Silica	48·63	48·29	43·06
Lime	25·39	26·59	24·34
Alumina	20·70	20·47	11·47
Iron sesquioxides, with manganese ..	traces	traces	7·24
Magnesia	2·93	·85	9·06
Water	2·35	2·53	3·42
Loss	..	1·27	1·41
	100·00	100·00	100·00

Nos. 1 and 2 are white minerals, with rare mottlings and striæ of a dark red colour; they are dull and opaque, but in thin sections translucent; easily fusible in the blowpipe, with intumescence to transparent beads, giving faint reaction of soda. No. 3 has a general similarity to the others, but is uncoloured, and fuses to a yellow-coloured bead in the blowpipe

flame (Col. Mus. and Lab. Rep., vi., p. 16). Specimens have also been brought from the Buller River by Dr. Hector (Col. Mus. and Lab. Rep., vii., p. 26), and from the Wairau River, Nelson, by Mr. A. McKay (Col. Mus. and Lab. Rep., xiii., p. 35).

Garnets, $\dot{R}^3 \ddot{Si}^2 + \dddot{R} \ddot{Si}$, are of very common occurrence in New Zealand, associated with the crystalline rocks of the West Coast, and also with the quartz porphyries and pitchstones of Canterbury; they are also frequently found in the auriferous washes of various localities, numerous specimens having been forwarded by diggers who have mistaken them for tinstone. They are mentioned by Dr. v. Hochstetter in mica schist at Collingwood, and in the gold-wash of the Takaka Valley (New Zealand, 1863, Eng. ed., pp. 103, 107); by Dr. Hector, (manganese variety), in gneiss granite and quartzite of the West Coast (Jurors' Rep. N.Z. Ex., 1865 pp. 266, 437), in the Kakanui River, as lime-iron garnets (Jurors' Rep. N.Z. Ex., 1865, p. 437), in the gold-wash of Stewart Island (Trans. N.Z. Inst., vol. ii., p. 185), and in the gold-wash of the South (Trans. N.Z. Inst., vol. ii., p. 371); by Dr. v. Haast, as almandine in the quartz porphyries and pitchstones of the Malvern Hills and Mt. Somers (Jurors' Rep. N.Z. Ex., 1865, p. 257, and Geol. Rep., 1873-74, p. 9); by R. Daintree, Esq., F.G.S., in trachytic rocks and pitchstones of Snowy Peak Range (Trans., N.Z. Inst., vol. vii., p. 459, and by myself in gneiss and quartzose porphyry (granulite) at Resolution Island. Besides these garnets have been forwarded from Nelson by Mr. C. Broad, from Karaka Creek, Thames, by Mr. Davis, from Brighton, Wanganui, by Mr. Duigan, from Anatoki, by Dr. Hector, and from Mount Rangitoto, Westland, by Mr. E. Steward. There are, in the collection of the Colonial Museum, specimens of almandine, of a pinkish red colour, in granulite, from Dusky Sound; of fine garnet sand, from the West Coast of Nelson, and of iron garnets in schist from Collingwood, in gneiss from Dusky Sound, and also in a quartz vein from the same locality, and as a garnet-rock from Otago. The prevailing crystalline form is the rhombic dodecahedron, but the icositetrahedron is also of frequent occurrence in the specimens from Dusky Sound.

Muscovite, $3 \dddot{Al} \ddot{Si} + \dot{K} \ddot{Si}^3$, is of very frequent occurrence in New Zealand as a constituent of the mica schist, gneiss, and granite of the West Coast. Some fine plates occur at Charleston, and also in Mitre Peak, Milford Sound. Its occurrence is mentioned by Dr. Hector in the schists and gneiss of the West Coast (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437), and in a dyke granite on Great Barrier Island (Trans. N.Z. Inst., vol. ii., p. 375); in the granites and schists of the West Coast, by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 257; and as brown mica in a trachytic rock and silvery mica in a granitic rock at Snowy Peak Range, by R.

Daintree, Esq., F.G.S. (Trans. N.Z. Inst., vol. vii., p. 458), and is again alluded to by Prof. Liversidge, from Dusky Bay and Charleston. (Trans. N.Z. Inst., vol. x., p. 497).

Lepidolite.—The occurrence of this mineral is mentioned by Dr. Hector in the gneiss of the West Coast and in the marble of Thompson Sound (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437).

Biotite, $\dddot{Al}\ \ddot{Si} + (\dot{Mg}, \dot{K}, \dot{Fe})^3\ \ddot{Si}$, is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437) as occurring on the West Coast, and there are specimens in the collection of the Colonial Museum from Milford Sound and Doubtful Inlet. In the last locality it occurs as a black-green mica rock with numerous minute crystals of zircon.

Rubellane is mentioned by Dr. v. Haast as occurring in the volcanic rocks of Banks Peninsula (Jurors' Rep. N.Z. Ex., 1865, p. 257).

Lepidomelane, $(\dddot{Al}\ \dddot{Fe})\ \ddot{Si} + (\dot{Fe}, \dot{K})\ \ddot{Si}$.—This mineral is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437) in the schists and gneiss of the West Coast, and there are specimens in the collection of the Colonial Museum from Milford Sound, where it occurs in thin hexagonal plates of a blackish-green colour, bronze by reflected light in certain positions; streak, dirty green. Thin laminæ slightly flexible, rather brittle. Before the blowpipe becomes bronze-yellow, and does not fuse.

Margarite, $\dddot{Al}^2\ \ddot{Si} + (\dot{Ca}, \dot{Na}, \dot{Mg})\ \ddot{Si} + \dot{H}$, is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437) in the schists and gneiss of the West Coast, and by Dr. v. Haast from the same localities (Jurors' Rep. N.Z. Ex., 1865, p. 257). There is a small specimen in the collection of the Colonial Museum from Milford Sound of a pearl-grey colour.

Chrome Mica.—This mineral is a chrome-magnesian mica, occurring in flat tabular plates of a green colour, and belongs to the hexagonal system. It is talcose in appearance and feels soapy to the touch, but Mr. Skey's analysis precludes its falling into the talc group, and it must therefore be considered as a chrome-magnesian mica, the percentage of water in which is somewhat high. A somewhat similar mineral from Schwartzenstein, analyzed by Schafhautl, is mentioned in Dana's System of Mineralogy, but it contains more silica and less alumina than this specimen.

	Schwartzenstein.	Dead-horse Gully.
Silica	47·68	39·25
Alumina..	15·15	22·12
Chromic oxide	5·90	1·56
Ferric oxide	5·72	18·69
Manganous oxide ..	1·05	·41
Magnesic oxide.. ..	11·58	10·60
Sodic oxide	1·17 }	1·13
Potassic oxide	7.27 }	
Water	2·86	4·06
Lime	—	2·18
	98·38	100·00

It was obtained from Dead-horse Gully, Lake Wakatipu, by Mr. McKay, who states that it occurs on the strike of the Moke Creek copper lode. A similar mineral has been forwarded by Mr. W. Docherty from Dusky Sound where it occurs in gneiss.

Orthoclase, $\dddot{\mathrm{Al}}\ \ddot{\mathrm{Si}}^3 + \dot{\mathrm{K}}\ \ddot{\mathrm{Si}}^3$, occurs as a constituent of the granites, syenites, gneiss, trachytes and rhyolites of New Zealand. It is mentioned by Dr. Hector as occurring in all the schists and crystalline rocks of the West Coast (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437), in granite from the Auckland Islands, and in granite and hornblende rocks from Ruapuke (Trans. N.Z. Inst., vol. ii., pp. 183, 185), in dyke granite at Great Barrier Island (Trans. N.Z. Inst., vol. ii, p. 375), and as sanidine in the trachyte of the Sugar Loaves, Taranaki (Geol. Rep., 1866-67, p. 8); by Dr. v. Hochstetter as sanidine in the rhyolitic tufas of Lake Taupo, and flesh-coloured felspar in the syenite of the Boulder Bank, Nelson (New Zealand, Eng. ed., pp. 385, 471); by Dr. v. Haast in the granite and other crystalline rocks of the West Coast, and as sanidine in the trachytes and trachydolerites of Banks Peninsula (Jurors' Rep. N.Z. Ex., 1865, p. 257, and Trans. N.Z. Inst., vol. xi., p. 504); and by R. Daintree, Esq., F.G.S., in dolerite of the Hororata district and Acheron section; in trachytic rocks at Mt. Misery and Snowy Peak Range and also in a granitic rock and pitchstone at Snowy Peak Range (Trans. N.Z. Inst., vol. vii., p. 458). The specimens in the collection of the Colonial Museum are a pink variety in granite from Dusky Sound, and a yellowish white specimen in a granitic dyke from Great Barrier Island.

Albite, $\dddot{\mathrm{Al}}\ \ddot{\mathrm{Si}}^3 + \dot{\mathrm{Na}}\ \ddot{\mathrm{Si}}^3$, is mentioned by Dr. Hector in the diorites of the West Coast (Jurors' Rep. N.Z. Ex., 1865, pp. 266, 437); by Dr. v. Haast in dioritic porphyries of the River Wilkes and Makarora Ranges (Jurors' Rep. N.Z. Ex., 1865, p. 257); by Mr. E. H. Davis at the Dun Mountain (Geol. Rep., 1870-71, p. 112); and by Prof. Liversidge from George Sound (Trans. N.Z. Inst., vol. x., p. 498). There is a white massive form, with chlorite, from Maori Point, Shotover, in the collection of the Colonial Museum.

Labradorite, $\dddot{\mathrm{Al}}\ \ddot{\mathrm{Si}}^2 + (\dot{\mathrm{Ca}}, \dot{\mathrm{Na}})\ \ddot{\mathrm{Si}}$, is mentioned by Dr. Hector in trachydolerites from Flagstaff Hill (Jurors' Rep. N.Z. Ex., 1865, p. 437); and by Dr. v. Haast in lava streams at Banks Peninsula (Jurors' Rep. N.Z. Ex., 1865, p. 257), and in the basalts and as large crystals in the dolerites of Banks Peninsula (Trans. N.Z. Inst., vol. xi., p. 499). There is a specimen in the collection of the Colonial Museum from Purahanui, Otago, of a dirty brown colour, showing play of colours on cleavage planes, and another, of a grey colour, in dolerite from Mt. Charles, Otago.

Saussurite is mentioned by Dr. v. Haast in gabbro from Mt. Torlesse (Jurors' Rep. N.Z. Ex., 1865, p. 257).

Oligoclase, $2\,\overset{...}{\text{Al}}\,\ddot{\text{Si}}^{3} + (\dot{\text{Na}}, \dot{\text{Ca}})^{2}\,\ddot{\text{Si}}^{3}$, is mentioned by Dr. v. Haast in quartz porphyries of Mt. Misery and Malvern Hills (Jurors' Rep. N.Z. Ex., 1865, p. 257), and R. Daintree, Esq., F.G.S. (Trans. N.Z. Inst., vol. vii., p. 458), mentions the occurrence of a plagioclase felspar, which is probably oligoclase, in granite from Snowy Peak Range.

Obsidian is mentioned, by Dr. v. Hochstetter, with rhyolites in the Taupo district (New Zealand, Eng. ed., p. 407); by Dr. v. Haast, on the sides of trachytic dykes (selbands) in Banks Peninsula (Jurors' Rep. N.Z. Ex., 1865, p. 257, and Trans. N.Z. Inst., vol. xi., p. 504); and by Mr. J. A. Pond, in the volcanic rock from Mr. Firth's well near Mt. Eden, Auckland (Trans. N.Z. Inst., vol. vii., p. 406). Its distribution in the North Island is widespead in the volcanic regions which occupy the central and north-east portions of the island; but, so far as I am aware, no solid flöes have been discovered, and the mineral has only been found in isolated blocks. It was formerly largely employed by the Maoris for the manufacture of weapons and implements. There are several specimens in the collection of the Colonial Museum from Taupo and White Island.

Pumice.—Is found throughout the volcanic region of the central portion of the North Island whence it is brought down to the sea by rivers, and distributed along the coast by the action of the tides and currents. It is mentioned by Dr. v. Hochstetter (New Zealand, Eng. ed., p. 43) as occurring in plateaux round Lake Taupo, 2,000 feet above the sea and he states (p. 384) that Mr. Grace's house is built of it. It is mentioned (Jurors' Rep. N.Z. Ex., 1865, pp. 35, 253) from the beach near Napier, where it is found in considerable quantities, brought down by the rivers from the north and also from Waikato, and Mr. J. C. Crawford (Trans. N.Z. Inst., vol. vi., p. 356) states that it occurs in large quantities at Tokano and (Trans. N.Z. Inst., vol. viii., p. 377) that pumice floats down the Wanganui River in such quantities that it would be easy for a ship, anchored in the river, to put out nets and so load the ship. Around the volcanic group of Ruapehu and Tongariro there are immense areas covered with pumice, and at Kereru, Napier, and many other localities on the east coast of the North Island, there are extensive deposits of compact white pumice-sand, which are mentioned by Mr. McKay (Geol. Rep., 1876-77, p. 81).

Pitchstone.—The only district in New Zealand where this mineral occurs is between Mt. Somers and Snowy Peak, where it is associated with quartz porphyries of which it appears to be the vitreous form, a complete series representing the change from a fluid pitchstone, through various stages, to a quartz porphyry with felsitic base and small crystals of quartz and garnet in which no fluxion structure is visible. It is of all colours, from grey to

brown and red, and occurs in considerable quantities at some places. It is mentioned by Dr. v. Haast (Jurors' Rep. N.Z. Ex., 1865, p. 257, and Geol. Rep., 1873-74, p. 9) associated with the quartz porphyries of Mount Somers and Snowy Peak.

Aluminates of Magnesia and Glucina.

Spinel, $\mathrm{Mg}\ \dddot{\mathrm{Al}}$.—The occurrence of rubies with garnet and topaz in the alluvium of Waipori, Otago, is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, p. 416). This mineral is also mentioned from Manawatu, Wellington (Col. Mus. and Lab. Rep., v., p. 18) as rhombic dodecahedrons, and nearly opaque. They were not analyzed, and so are very probably garnets.

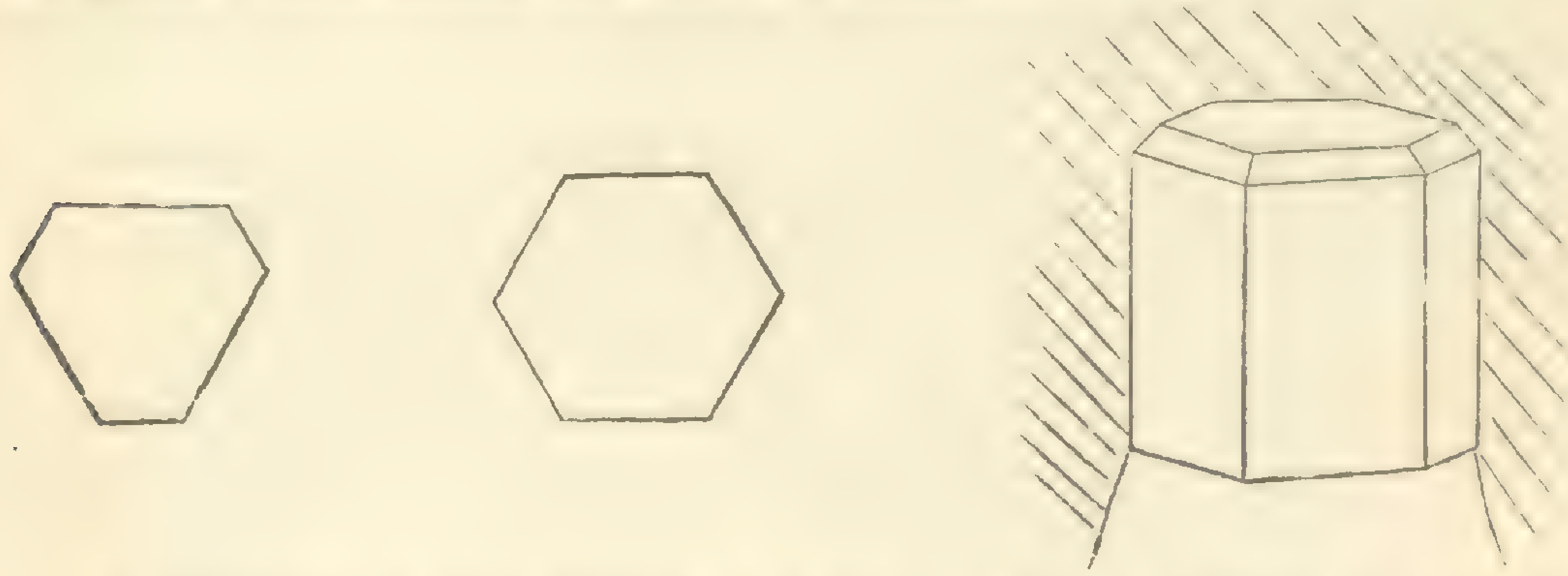
Silicates of Glucina, Zirconia, Thoria, and Yttria.

Zircon, $\ddot{\mathrm{Zr}}$, $\ddot{\mathrm{Si}}$.—The occurrence of this mineral is mentioned by Dr. Hector (Jurors' Rep. N.Z. Ex., 1865, pp. 417, 438), who says "crystals of zircon were exhibited, in the Museum of the Geological Survey, from Timbril's Gully," and (Trans. N.Z. Inst., vol. ii., p. 371) with platinum and gold in the wash of the south; and by Dr. v. Haast from the western slopes of the Southern Alps (Geol. Rep., 1870-71, p. 24). In the collection of the Colonial Museum there is a specimen of a biotite rock from Doubtful Inlet, Otago, in which there are numerous minute tetragonal prisms with pyramidal ends of a bright red colour, transparent, which are probably zircons.

Topaz, $5\ \dddot{\mathrm{Al}}\ \ddot{\mathrm{Si}} + (\mathrm{Al}\ \mathrm{F}^3 + \mathrm{Si}\ \mathrm{F}^2)$.—Is mentioned by Dr. Hector at Chatto Creek, Arrow River, and Waipori (Jurors' Rep. N.Z. Ex., 1865, pp. 265, 438); and (p. 416) he says, "in collections from the Otago Goldfields' department were some uncut topazes as large as pigeons' eggs, and of a pure white colour. Several smaller topazes of various colours have lately come into the possession of the Geological Survey of Otago from the neighbourhood of Waipori, where they are found in the alluvium along with rubies, garnets," etc.

Emerald, $\dddot{\mathrm{Al}}\ \ddot{\mathrm{Si}}^3 + 3\ \dot{\mathrm{Gl}}\ \ddot{\mathrm{Si}}$.—Specimens of this mineral have been forwarded from Dusky Sound by Mr. W. Docherty, of which Mr. Skey says:—"This is a somewhat rare mineral collected by Mr. William Docherty, from a vein in the vicinity of Dusky Sound. When tested, it was found to be the mineral beryl, the distinguishing feature of which is the presence therein of the rare metal glucinum (beryllum.) Usually, this is to the extent of 12 to 15 per cent. in specimens of this kind. The mineral is of a full rich green colour, which it owes to the presence of sesquioxide of chrome. It occurs at Dusky Bay, in a pyrrhotiniferous quartz, forming little nests of confusedly crystalline masses having a tendency to assume a tabular form."

I have since examined these specimens, and find the following sections of crystals, which confirm Mr. Skey's determination :—



The hardness of the mineral is about 7, and it occurs in the more quartzoze portions of a syenitic gneiss, associated with garnets, pyrrhotine and chrome mica, as other accessory minerals.

Tourmaline, $n\ \dddot{R}\ \ddot{Si} + \dot{R}^3\ \ddot{Si}$, is mentioned by Dr. Hector in the granite and gneiss of the West Coast (Jurors' Rep. N.Z. Ex., 1865, p. 266) ; by Dr. v. Haast, in granite, at Mosquito Hill on the West Coast (Jurors' Rep. N.Z. Ex., 1865, p. 257), and by myself in micaceous and hornblende schists at Resolution Island (Geol. Rep., 1874–76, p. 31). There are some very fine specimens of schorl in chlorite schist, from Collingwood, in the collection of the Colonial Museum, arranged as long, black, striated prisms in broken strings which radiate from a centre ; they vary from a sixteenth of an inch to a quarter of an inch in diameter. Some very beautiful little acicular crystals in quartz, from Bedstead Gully, Collingwood, are also in the collection ; they are of a deep black colour, and red by transmitted light. A blackish green variety also occurs in the granite of Tata Island, Nelson.

Art. XLVIII.—*On a new Mineral belonging to the Serpentine Group.*

By S. Herbert Cox, F.C.S., F.G.S., Assistant Geologist & Inspector of Mines.

(*Read before the Wellington Philosophical Society, 21st October, 1882.*)

Hectorite.—This mineral is described (Col. Mus. and Lab. Rep. xv.) as an altered form of augite, but is more nearly allied to the hydrous silicate of the Serpentine Group. As, however, it does not correspond in composition with any described mineral, I have given it the name of Hectorite.

Its composition, as determined by Mr. Skey, is—

Silica	57·89
Ferrous oxide	18·46
Alumina	4·74
Ferric oxide	traces
Manganese	"
Lime	1·99
Magnesia	13·94
Water	2·98
	100·00

Description.—Rhombic, in radiating groups, which separate in thin flexible laminæ. Hardness 2 to 2·5; colour, whitish green to dark green, weathering to a bronze hue and pearly lustre. B.B. infusible, but becomes white; odour, bitter argillaceous when breathed upon. Allied to picrosmine and antigorite. It is from the Dun Mountain, where it occurs with the serpentine rocks. It was collected by the late Mr. E. H. Davis.

Art. XLIX.—*Descriptions of some new Tertiary Shells from Wanganui.*

By Professor F. W. Hutton.

[*Read before the Philosophical Institute of Canterbury, 7th September, 1882.*]

A short time ago a collection of over a hundred species of Mollusca from the Wanganui bed was submitted to me for determination by Mr. S. H. Drew, of Wanganui, and in it I found the following forms which appear to be undescribed:—

Trophon expansus, sp. nov.

Shell ovate; spire moderate, acute: whorls five or six, spirally grooved, the grooves narrower than the ribs, about 26 grooves on the body-whorl, crossed by undulating laminæ of growth worn smooth. Aperture ovate, wide, slightly angled behind; outer lip expanded; columella rounded, with a small posterior canal: anterior canal very short and recurved.

Length, ·77 inch; breadth, ·4 inch. Length of spire, ·3; of aperture, ·85; of canal, ·12 inch.

This is one of the purpuroid Trophons, but with a rounded columella; it is so like the figure of *Purpura patens*, H. and J., that I should have considered it the same, but that the authors state that *P. patens* has the columella very flat.

Cominella drewi, sp. nov.

Shell ovate, spire short: whorls six, spirally lirate, about 22 liræ on the body-whorl; the spire-whorls finely longitudinally plicate. Aperture ovate, the posterior canal well marked: columella obliquely truncated; anterior canal well defined.

Length, ·78 inch; breadth, ·45 inch.

This species is distinguished from all our other species of *Cominella*, except *C. ordinalis*, Hutton, by being spirally lirate, and from this species it is separated by its well-marked anterior canals, which makes it intermediate between *Cominella* and *Euthria*.

Odostomia sherriffi, sp. nov.

Shell subulate, tapering: whorls fifteen, smooth, flattened and polished, the suture deep. Aperture ovate; peritreme not continuous; columella with one strong plait.

Length, ·55 inch; breadth, ·17 inch.

Named after Mr. G. Sherriff, of Wanganui.

Trochita inflata, sp. nov.

Shell subglobose; whorls two and a half rounded; the last inflated, with four or five distant, narrow, spiral ribs crossed obliquely by lines of growth: apex lateral. Aperture ovate, the lamina concave.

Height ·4 inch. Length of aperture ·88; breadth ·72.

This species has externally the appearance of a *Natica*, but the surface is not polished.

Anthora conica, sp. nov.

Shell conical, high; whorls seven, slightly convex, with fine spiral moniliform ribs, about eight on the penultimate whorl; suture deep; base of the last whorl spirally striated with moniliform striæ, the angle rounded. Axial cavity deep, smooth, conical; columella with a slight posterior fold.

Height ·84 inch; breadth ·84 inch.

This species has the smooth axial cavity of *A. tiarata*, but it is larger, higher, the granulations finer, and the basal angle much more rounded.

NOTE.—In addition to these new species there was in the collection a specimen of what I take to be *Siphonaria fuscozonata*, Angas (P.Z.S., 1865, p. 56), which appears to be the same as *Fusus minutisquamosus*, Reeve.

ART. L.—*Note on the Silt Deposit at Lyttelton.* By Prof. F. W. HUTTON.

[*Read before the Philosophical Institute of Canterbury, 6th April, 1882.*]

IN cutting back the hill on the west side of Lyttelton Harbour to make room for the dock, an excellent section has been exposed of the silt deposit and the rocks underlying it. An uneven surface of volcanic rocks is covered by the silt, which is distinctly stratified, and dips at an angle of 8 degrees to the north-east, that is towards the harbour. In 1873 the cutting behind the

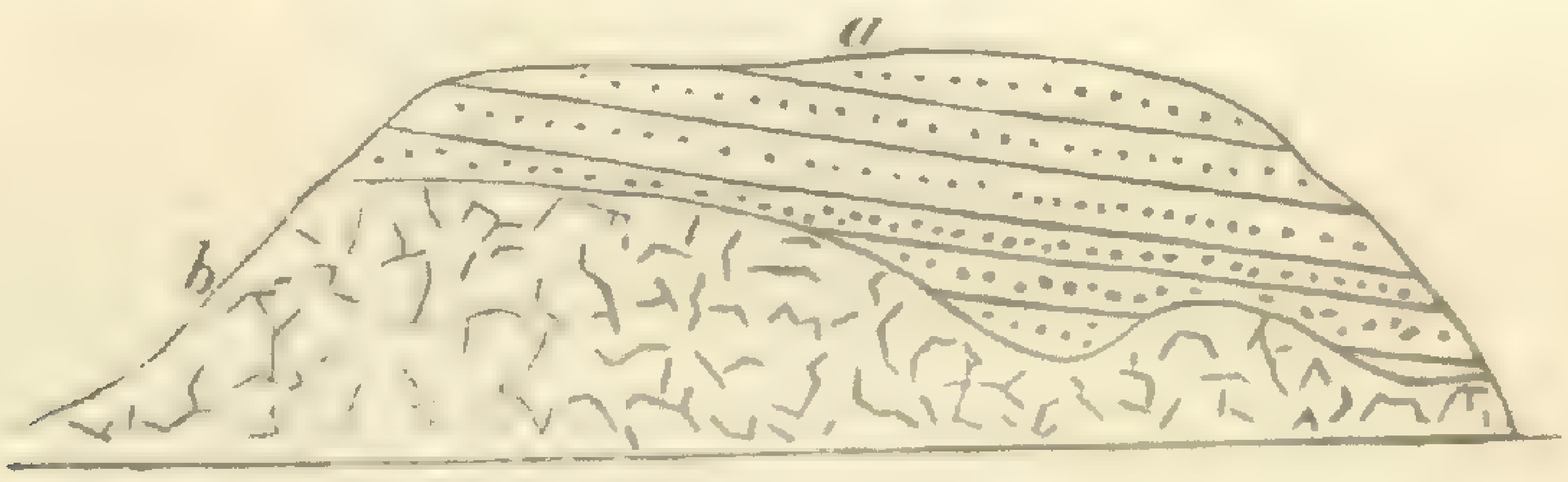


Fig. 1. *a*, silt deposit; *b*, volcanic rocks.

railway station also showed that the silt was stratified, but this section is now obliterated by weathering, and I have thought it important to call the attention of geologists to the section behind the dock while it is still fresh; for no doubt it will soon become obliterated like the one behind the railway station.

The origin of this silt deposit is of considerable interest, as it is important evidence in discussing the question of the latest oscillations of level in New Zealand. Dr. von Haast, in his Report on the Geology of Canterbury and Westland (1879), p. 367, calls it "The Loëss Formation," compares it with the loëss deposits of China described by Baron von Richthofen, and says that "the general character and position of the principal loëss (or loam) beds in this province prove clearly that they have been formed by the *modus operandi* pointed out by Von Richthofen." There is, however, one difference which he mentions, "and that is the absence in the Canterbury beds of the peculiar small marly nodules so common on the Rhine, the Danube, and in China."

The *modus operandi* in question is the following: The fine particles of earth carried down the slopes by the rain are partly retained by the grass growing on the slopes, and the dust blown across the land by the wind is also retained by the grass, the roots of which also decay and assist in raising the ground;—so that the formation is a mass of grass covered with fine earth and sand brought by the wind and the rain, and has, of course, an entirely subaërial origin. It is characterized by being unstratified, and by having a "peculiar vertical capillary texture," caused by the decay of the roots of the grass.

I am afraid that the well-marked stratification of the base of the Lyttelton silt deposit can hardly be reconciled with this method of formation, and there are several other difficulties which cannot, I think, be explained on the theory of a sub-aërial origin.

In the first place the deposit is widely distributed and rests upon beds of very different mineral composition. According to Dr. von Haast it is found at the foot of Mount Grey and on the Moeraki Downs, where it lies upon tertiary argillaceous and calcareous sandstones; at the Malvern Hills, where it rests upon secondary sandstones and slates. At the southern end of the Canterbury Plains it occurs from the Orari to Timaru, where it is found on tertiary sedimentary and volcanic rocks; and in some places it lies on the shingle of the Canterbury Plains. South of Timaru it can be traced beyond the Waihao, and in the valley of the Waitaki south of Elephant Hill. From my own observations I know that it is largely developed at Oamaru, where the base is also stratified, and that it extends as far south as Moeraki Peninsula. It is difficult to understand how so

widely extended a deposit, resting on such different rocks, could be formed in the way suggested by Dr. von Haast; and it is also difficult to understand why, on this hypothesis, the deposit should be found only on the coast near the mouths of the great rivers from the Waimakariri to the Waitaki, and not elsewhere.

In the second place the limit in height of the deposit must be noticed. In the "Transactions of the New Zealand Institute," vol. vi., 1873, p. 423, Dr. v. Haast says that on Banks Peninsula it extends to a height of 800 feet above the sea; and in his Report on the Geology of Canterbury he says that at Timaru it reaches to near the summit of Mt. Horrible, which is 1,272 feet high. No other data can be obtained at present, and the difficulty here is to explain why, on the subaërial hypothesis, its height on Banks Peninsula should be limited to 800 feet, notwithstanding that grass grows, rain falls, and the wind blows at much greater altitudes.

In the third place the silt deposit is not confined to the slopes. At Oamaru it covers the very highest points of Oamaru Cape, as may be seen in fig. 7, page 55, of my report already quoted; and in many parts of Banks Peninsula it is better developed on the ridges than in the valleys, as the accompanying sketch of the cliffs between Little Akaloa and Mackintosh Bay will show (fig. 2); so that the action of rain in its formation must be eliminated.

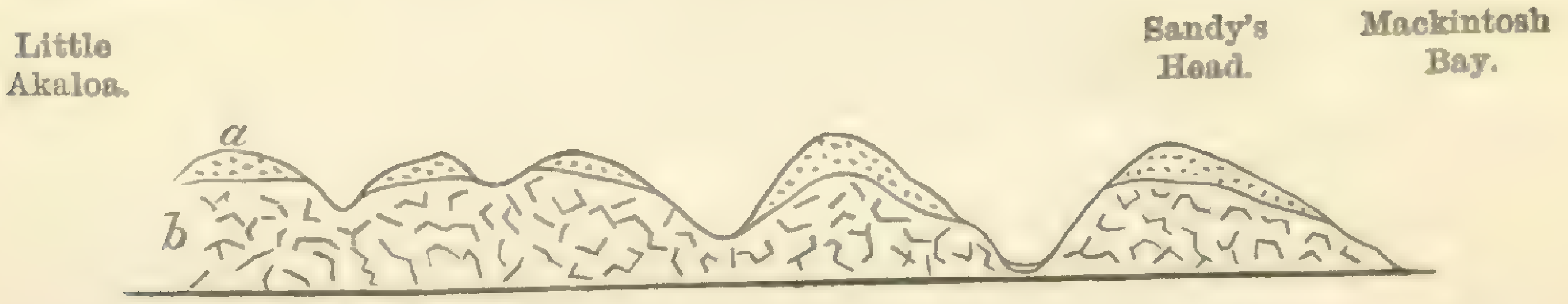


Fig. 2, *a*, silt deposit; *b*, volcanic rocks.

The last point to be noticed is the fossils contained in the deposit. Usually it is quite unfossiliferous, but Dr. von Haast states that moa bones and land shells have been found in it somewhere on Banks Peninsula, but no definite locality is named. The occurrence of land shells is remarkable considering how rare they are now in New Zealand, and that they are almost entirely confined to the bush. I have never heard of any land shells having been found on grass land except in crevices of limestone, or under blocks of the same rock; and there is no limestone on Banks Peninsula, while, according to Dr. von Haast's hypothesis, the formation accumulated on open grass land.

At Oamaru marine shells of still living species are found in the lower part of the deposit up to a height of 60 feet above the sea. A list of the species will be found at page 70 of my "Report on the Geology of Otago," 1875.

Moa bones are also found in the deposit at Oamaru in the position figured on page 71 of the report just named. Dr. von Haast also says, in his Report on the Timaru District (1865), that this silt deposit is underlaid by fine clay or gravel, sloping up from the sea to a height of 686 feet, and containing recent marine shells near the sea; (see also Report on the Canterbury Plains, 1864, p. 8). The difficulty here is to explain the presence of marine shells at Timaru and at Oamaru, in the latter place in beds of gravel distinctly interbedded with the silt.

All these facts are explained on the hypothesis that this silt deposit is due to the fine mud brought down by the great rivers and deposited on the bottom of the sea when the land stood some 1,000 feet or so lower than it does at present. Two other difficulties, however, now present themselves. First, the absence of marine fossils in the upper part of the deposit; and, secondly, the absence of sea-cliffs at high levels in Banks Peninsula. Both these are cases of negative evidence and of no great weight. Many undoubted marine formations are devoid of fossils, and in our case this may be due to the rapid deposition of the silt, or to the unfavourable nature of the sea-bottom for marine Mollusca. The moa bones, of course, offer no difficulty; they are the remains of birds floated down the large rivers. With regard to the absence of sea-cliffs on Banks Peninsula—which, however, cannot yet be said to be certainly established—we must remember that sea-cliffs are formed only when the land is stationary, and that, if the movements of depression and elevation were continuous, no sea-cliffs would be formed, or only such small ones as would be easily obliterated.

It appears to me, therefore, that the evidence in favour of the marine origin of this deposit preponderates enormously over the evidence in favour of its subaërial origin.

Art. LI.—*On the Formation of the Quartz Pebbles of the Southland Plains.*

By W. S. Hamilton.

[*Read before the Southland Institute, 9th May*, 1882.]

The great abundance of white quartz pebbles about Invercargill, and all over the seaward portion of the Southland Plains, is quite a feature of its geology. To strangers visiting the district, the first question that suggests itself is, where has all that quartz come from?

The usual hypothesis entertained is, that great mountain masses have been washed down by the action of the sea, or by the great annual rainfall, and that the quartz reefs or dykes in these mountains, being harder than the adjoining strata, have withstood the action of the water, and appear as

water-worn pebbles in our diluvium. On closer examination, however, it is found that this hypothesis cannot be the true one. In all the mountains which surround the plains in question, such as Longwood, the Takitimos, the Hokonuis, and the mountains to the east of Wyndham, quartz veins are of rare occurrence, and form a quite insignificant part of the whole. It is also seen that the detritus or gravel formed at the base of these ranges is of quite a different character to that under our notice. The gravel of the beds of the Oreti and Mataura formed from these mountains is, for the most part, blue in colour and composed of very hard sandstone or slate.

The upper plains of Southland, such as the Waimea, Mararoa, Otapiri, and Lora Plains, are composed of gravel of this kind, while the lower plains near the sea-level are composed of heavy beds of milk-white quartz of the kind we are speaking of; and it is further found by the bores that have been made, that these beds alternate with heavy beds of clay and seams of lignite to the depth of more than 200 feet. These beds of quartz could not, therefore, have been deposited from the mountains behind our plains on the landward side.

Similar difficulties stand in the way, if we suppose them to have been derived from the seaward side. The syenite of the Bluff hill contains plenty of quartz, but only as a component of a rock as hard as quartz itself; and which water wears into round balls remarkable for their great elasticity and hardness.

The Stewart Island granites could not account for the deposition of these beds anything more easily: nor the sandstones of Ruapuke, or the Greenhills.

The only remaining possible supposition is, that there were mountains of quartz *in situ*, which were degraded on the spot, and left these beds to mark the place where they stood. This is so unlikely that it can hardly be entertained, as mountains of this kind occur nowhere else in the neighbourhood, and even if such had been the case here, the great hardness of such mountains must have resisted the denuding forces as much as the sandstones and the granites in their neighbourhood. No vestige or evidence of such mountains is anywhere seen, while the beds of clay and lignite would have to be otherwise accounted for.

However much geologists may object to it, the true theory of the formation of these pebbles seems to be, that they are silicified wood; and the more they are examined, the more convincing does the proof become that these beds represent, in one condition, the remains of ancient forests, just as the coal beds represent the same thing in another condition. On examining these pebbles closely, it is seen that, in almost every case, the appearance of wood structure can be detected. In some cases it is quite perfect; the

annual growth-rings, the medullary rays, and the vascular tissue being easily seen. Their crystallization is quite peculiar, differing entirely from reef-quartz in being vesicular, or something like what snow is to ice; and much softer than rock-quartz, so that in many cases they can be scratched with a knife. They are all flat-shaped, or knot-like; just as if they had been originally pieces of bark, or knees, or resinous knots, which had resisted the action of ordinary putrefaction long enough to become completely silicified.

Specimens are found showing the different stages of the process, from lignite to perfect quartz. The small set accompanying this paper may be referred to and described. No. 1, from the Hokonuis, in conglomerate, is unmistakable wood, evidently a root of black pine (*Podocarpus spicata*) or kowhai (*Sophora tetraptera*). It is very hard, rings like clinkstone on being struck, and is dark blue in colour, evidently from the carbon not being quite oxidized out. In this respect it is exactly like a clay pipe when insufficiently burnt, part of the carbon of the nicotine remaining in the form of soot to stain the pipeclay blue. In every respect this specimen is perfect stone, giving sparks with steel, and with a specific gravity equal to quartz. Its perfect woody structure and charcoal colour alone betray its origin. In time the blue colour would no doubt have given place to white or grey, when the last vestige of its carbon had been oxidized to CO_2. No. 2 is from the top of the coal at the Nightcaps, and shows the wood first changed to lignite, on the under side, while the upper, or that exposed to the atmosphere, is becoming white, hard, and quartz-like, with a burnt appearance. No. 3 from the same locality shows this burnt appearance to such a degree that one would conclude on looking at it that it had been through the fire. Such, however, could not have been the case as it was detached from the solid seam by the writer.

These specimens show that carbon gets away from wood remains in all probability as CO_2 by slow combustion at ordinary temperature; and when silica is supplied in the same proportion by highly silicated water, the condition has in all probability been attained for the preservation of the structure, after every other trace of its original has disappeared.

Had the water absorbed by the decaying timber been unable to supply the silica in the proper proportion to replace the carbon as it oxidized, caverns in the quartz would probably have been formed, or a vesicular structure, if more nearly equal to the demand,—just what is often observed in these specimens. If the supply of silica was in exact proportion to the departing carbon, perfect opal would be the result; while if from increase of temperature from any cause, fermentation and putrefaction set in, the carbon would get away so rapidly that no silicification could take place,

and no remains whatever would be left to tell the story of the kings of the forest as we see them embalmed in these specimens in their mummy-cases of milk-white quartz.

From this point of view our plant and forest remains are disposed of in nature in three different ways, viz. :—

1. They rot and mix with the soil, where the carbon slowly oxidizes in the earth. This is proved by experiment. The air of the soil is found to contain far more carbon dioxide than the atmosphere, and thus the CO_2 of the soil is far greatest during the summer months, when the temperature is high. Pettenkoffer (Watt's Chem. Dic. 3, Sup., p. 133) found that the quantity of CO_2 in the air of the soil increases very gradually from the greatest depth examined by him—about fourteen feet—upwards to the surface, and that during August and September, at Munich, it was five times greater than it was in January. This can only be from the gradual oxidizing of the woody matter of the soil—at least the presumption is very strong that it is so, although some are of opinion that it may be obtained from some of the lowest forms of animal life.

2. The remains of plants and trees may oxidize so gradually that, in a silicious soil where they absorb silicious water, they may be silicified, and may thus form vast gravel beds of quartz, or of nodules of sandstone composed of quartz, lime, magnesia, potash, etc., in combination, according as the trees or the vegetation were rich in these. In this way our lignite beds may pass by oxidation into sandstones or slate or marl, according as the original vegetation was rich in silica, alumina, or lime, and according as the water absorbed by it was rich in these elements.

3. Or these remains may—by being excluded from the atmosphere by accident, or where deposited in great thickness—form beds and seams of coal which may resist for a long time the oxidizing influence of the air. Coal seams are almost always found to have been protected from the air and from silicious water by dense beds of fireclay above and below, impervious to water and air and other elements inducing change. These deposits depending only on rare and accidental conditions will, therefore, be the exception, and will be the least common way in which the carbon of these remains is disposed of.

These considerations lead us to suspect that vegetation may have had more to do with the formation of many of our sandstone rocks than is generally supposed. Many things strengthen such a supposition, such as the ash and plant beds so frequently met with, the eminently concretionary character of many, almost all of them, and the strange absence of fossil remains from many of our sandstones. The red and blue slates of our

Maitai formation, for instance, are not generally so metamorphosed as to have destroyed the fossil remains which were almost sure to have occurred had these beds been laid down by the agency of water.

The remaining specimens numbered 4, 8, 9, 10 still exhibit the structure of wood, but are completely converted into quartz, with a specific gravity of 2·6 to 2·8, and having grains of magnetic black sand, or thin laminæ of mica here and there between the growth-rings of the original wood, and in the caverns of the structure. These specimens may be picked up in thousands in our streets and in our gravel pits and cuttings, indeed scarcely a piece of quartz can be picked up which does not show woody structure. No. 5 is silicified wood resembling chert where the woody fibre is quite distinctly seen. No. 13 has woody fibre very fine and dense, but with true veins of crystalline quartz transverse to the fibre, just as if the wood in the lignite stage had, in shrinking, cracked and admitted the silicious water to deposit, amidst the chemical changes going on, true crystalline quartz.

The water-worn condition of these pebbles must have resulted from a submergence, probably very slight, of the plains for some time. Indeed the lignite beds alternating with beds of clay and quartz gravel prove conclusively that this was the case, and that such alternations of level must have taken place, a great many times, during probably long periods, since we meet with thin seams of lignite, alternating with clay and gravel in the most natural way, for more than 200 feet in the bores that have been put down in the neighbourhood of Invercargill. These plains, then, on which we live and move to-day, but slightly elevated above the tide, have been so (only sometimes just as much below tide-mark as they are now above) for long periods, during which immense forests grew, decayed, and became quartz gravel, while for correspondingly long periods the tide washed over them, covering up with clay the deposits of timber to make lignite of them, and polishing the pebbles which had passed into a more advanced stage of change through the oxidizing of the carbon of these vegetable remains.

This natural oxidizing of the carbon of the vegetable world at ordinary temperatures, or at temperatures considerably elevated under the surface, is probably a process which has not been comprehended in all its magnitude and importance. The small amount of carbon dioxide in the atmosphere (only about 3 in 10,000) has probably a misleading effect, leading us to conclude that the process must be very insignificant when the product is so small.

When we consider, however, that all the growing forests of the world, nay, the entire vegetable kingdom, derives its carbon principally from the carbon dioxide of the atmosphere, it will be comprehended what an enormous supply will be wanted. It will want little less than the oxidizing of

all the vegetable remains of the world to supply the demand, if the vegetable growth is to go on, and the forests are to maintain their extent and height. In this way the carbon is just the current capital of the vegetable kingdom ; the carbon dioxide in the atmosphere is the daily balance in the bank, which, like the reserve in the Bank of England, is found to be constantly changing ; while the coal deposits are what corresponds to dead capital, which man is doing a service to nature in digging up and oxidizing so that it may enter afresh into the currency of the vegetable kingdom. No doubt part of this carbon circulates through the animal kingdom as well, but it can hardly be supposed that all the carbon used up in vegetation could be supplied by the animal kingdom alone. It is much more probable that the great vegetable kingdom is completely balanced as to the demand and supply of its carbon, without the aid of the animal kingdom at all, and that the latter is merely a kind of parasite on the former.

The vast masses of carbonate of lime in the limestones of our marine deposits is another instance of dead capital, but there can be no doubt that the carbon gets away in this case too, and that the lime goes into combination with silica, etc., forming silicates, sulphates, etc., of lime, and that the limestone rocks slowly change into sandstones of various kinds. In this way the carbon of our planet seems only an instrument used in its architecture, being always withdrawn to be used over again, but not entering into its composition permanently.

ART. LII.—*On the Occurrence of Platinum in Quartz Lodes at the Thames Goldfields.* By J. A. POND.

[*Read before the Auckland Institute, 23rd October,* 1882.]

SOME months ago, while the shaft in the Queen of Beauty Gold-mining Company was being deepened from the 540 to the 600 feet level, a quartz vein was cut which descended nearly vertical, and finding this to be impregnated with massive pyrites, I decided to assay portions to prove as to its gold-bearing character. The first assay of 200 grains yielded bullion ·021, which, on parting in nitric acid, still retained its silvery lustre and appearance, showing that some other metal than gold was present, and this led me to continue the further examination of this vein. Making assays of the different portions of the stone, I obtained various values, the highest being ·776 grs. of bullion from 400 grs. of ore, which, after parting, was reduced to ·126 grs., or equal to 10 ozs. to the ton.

Placing the various beads together, I proceeded to isolate the metal, obtaining silver, gold, platinum, and iridium. My examination has only been a qualitative one as yet, as the breaking of a flask containing the whole

of my solution resulted in the loss of an unknown amount; and hence the absence of exact data. The assays made from this leader varied considerably, the lowest being at the rate of 1 oz. 5 dwts. 18 grs. to 10 oz. 6 dwts., showing that it was very irregularly present in the stone. When the peculiar characteristics of its presence are found it will be possible to isolate sufficient of the group to show the quantity of the other members of the platinum group which accompany it.

In the continuation of this investigation I have found this metal present in the large reef, both at the 540 feet and 600 feet levels, by assay, but in very much smaller proportions, and have washed several packets of tailings from the battery, the result of the crushing of this reef, and obtained the metal in the shape of minute grains accompanying the escaped gold. These grains viewed under the microscope are generally rounded, but a great many take the octahedral shape, some being beautifully perfect crystals. As it is intended to commence sinking immediately to the 670 feet level, I shall have ample opportunity of continuing my examination of this subject with a view to finding whether it is possible to note its presence in the stone by any visible peculiarity.

The rarity of this metal being found *in sitû* may be gathered from Ure, who remarks of a sample of ore containing platinum from Guadalcanal in Spain, "This would be the only example of platinum existing in a rock and in a vein." Since then, however, Edison in America and Roscoe and Schorlemmer have shown that it exists more largely than is generally presumed, and I think it is highly probable that if it was looked for systematically at the Thames, it would result in its being found much more widely distributed in the network of reefs and leaders than is generally supposed.

IV.—MISCELLANEOUS.

Art LIII.—*Our Earliest Settlers.* By R. C. Barstow.

[*Read before the Auckland Institute, 30th November*, 1882.]

I must commence by giving a definition of the word "settlers." I do not mean "colonists" thereby, because at the time of which I am about to speak, the notion of forming a colony in New Zealand,—(by colony, I understand a body of people transplanted from the parent state, but remaining in more or less subjection to it),—had not entered into men's minds; nor do I yet mean the first white people who came by chance to be dwellers in these islands, for these were, with one exception, runaway convicts from New South Wales and deserters from ships,—the former seeking to regain their liberty, the latter either disgusted at their treatment on board ship, or perchance beguiled from their duty by the blandishments of Maori maidens. To these classes may be added a few notorious miscreants whom masters of vessels, for their own safety, had put on shore. But the people of whom I am about to speak, were those who came here deliberately with the intention of remaining for years or for life. Their last survivor has but recently passed away.

These islands were first made generally known to Europe owing to Tasman's having anchored off the southern one so long ago as the year 1642. The hostility of the numerous inhabitants deterred him from attempting to land, but we owe to this visit the name which our country still retains, "New Zealand." We have no record of its having been again visited until Cook in 1769 reached its shores from Tahiti; but from this, and his two subsequent voyages hither, can be traced every successive step which has led to making New Zealand what we now see it to be. Through Cook became known its extent, populousness, fertility of its land, the excellence of its harbours, whilst upon the other hand the natives acquired pigs and potatoes, at the same time becoming acquainted with the uses of iron and firearms. We shall see presently the consequences of these so diverse subjects.

The accounts of Captain Cook's voyages led to two schemes of very different characters,—the one being the formation of a penal settlement at Port Jackson in 1788 by Captain Phillip with some 750 convicts; the other, the despatch by the London Missionary Society of a body of missionaries in 1796 to Tahiti, in the ship "Duff;" of this party a Mr. and Mrs. Henry

were still living when I was at Tahiti in 1844. Each of these expeditions had an influence upon our own land: Sydney, by the influx of settlers and convicts, rapidly became populous; ere long vessels were built there, and trading or exploring voyages undertaken. Those colonists were early stimulated to engage in the whaling trade, which London merchants, aroused by the narratives of Wallis, Carteret, and Cook, by the beginning of this century were pushing in the southern hemisphere (French privateers having rendered cruising in the north too hazardous); and both English and colonial whale-ships soon began to resort to New Zealand for wood and water, pork and potatoes, these latter already abundant from Cook's introduction of them. A life of adventure and excitement was congenial to Maori temperament; they shipped for a cruise, usually with a proviso that their discharge should take place at the port of departure, a stipulation too often disregarded when its execution was inconvenient to the master. Indeed, a New South Wales Governor (Macquarie) found it necessary to issue a proclamation against kidnapping New Zealanders and making them serve as sailors against their will. In these modes some Maoris found their way both to London and Sydney; whilst to this nearer port others went in trading vessels as passengers, being intent upon procuring axes and iron tools, but more especially covetous of the possession of firearms, whose deadly effects they had seen in all their early communications with the whites. Cook, a fairly humane man, had shot seven in his first week in New Zealand; and three years later Marion du Fresne, in retaliation for the slaughter of some of his crew, attacked a *pa* at the Bay of Islands and shot a large number of its inhabitants.

Many years back I tried to find out when the northern natives first became possessed of guns, and put the question to an aged chief of Ngatiwai *hapu*—the same people who had come into collision with Marion. He had not heard of any guns being captured when the Frenchmen were killed at Manawaora, but told me that he had helped to get the first gun that he knew of their possessing. He said that a party of sailors had landed some casks to get water, and, as it was cold, had made a fire to warm themselves by whilst the water was running by a spout into the casks. One of the crew walked up and down with a musket, as a sentinel, showing that amicable relations with the islanders could not be trusted to, but as no Maoris were visible he rested his gun against the steep bank of the gully, walked to the fire and, warming his hands, chatted to his comrades. Three young natives had, however, been watching the movements of the sailors, and marking the opportunity, one of them crept from his

concealment in the scrub, and, unobserved, possessed himself of the prize, which the three then hurried away with. For some time subsequently a warrior of the *hapu* always carried this piece in front of his war party as an "intimidator" to the enemy, though the mode of using it was quite unknown to them.

This must have happened prior to the destruction of the ship "Boyd," as the northern natives acquired then a considerable number of firearms, and had already learned their use, but must have been long after Captain Furneaux's boat's crew was cut off. Several of his party were armed. The northern natives might not have even heard of that event, as owing to the incessant hostilities prevailing amongst the people news would not reach far, and that tragedy happened on the South Island.

As far as I know, a Whangarei native, named Moehanga, was the first Maori who reached England, whither he was taken by a Mr. Savage in 1805. Moehanga was there looked upon as a great curiosity, and was presented to George III.; many useful articles were given him, and the Government sent him back to Sydney, whence he was forwarded to the Bay of Islands. Although Moehanga had a well tattooed face, he was a man of no importance: he was therefore soon bereft by his superiors in rank of the goods and tools with which he had been supplied, and incurred besides the too common misfortune of travellers, of being pointed out as a man who told such marvellous stories that he was deemed to be *porangi*, or insane.

To Sydney—Port Jackson as it was then generally called—Maoris had found their way much earlier. Captain King took two chiefs over in 1793, and a year or so later Te Pahi, chief of Rangihoua, a *pa* near the north head of the Bay of Islands, with several of his sons, went thither. As Te Pahi was favourably spoken of by the masters of whale ships and traders, he was made a good deal of by the Governor. An eager desire for cultivating trade in flax, timber for spars, salt pork, or any other return cargo for convict ships, existed, and it was hoped that by his means commerce of that kind might be developed. Te Pahi and family were conveyed back in a government vessel. Mr. Marsden, the Colonial Chaplain, had taken a great interest in him, and, during his stay at Paramatta, had managed to learn a few words of the Maori language. Te Pahi visited Sydney again some eight or ten years later.

By this time the success of the London Missionary Society at Tahiti had become known, and Mr. Marsden, stimulated by the accounts received thence, thought that a favourable opportunity now presented itself for a similar undertaking in this country. With this view he took Te Pahi to

his house, keeping him there for some months, partly with a desire to instruct him in the doctrines of Christianity and convert him, and thus open up a way for further operations amongst his people, and partly that he himself might learn from his guest something more of the language and customs of the inhabitants of these islands. Mr. Marsden, indeed, made a promise that ere long he would pay Te Pahi a return visit.

With this object, amongst others, Mr. Marsden obtained leave of absence and returned to the mother country, where he with some difficulty prevailed upon the Church Missionary Society to look favourably on his project, and to promise him £500 a year for its support. He induced a Mr. Kendall, by profession a school-master, but a man of some means and imbued with a love of adventure, to join in the undertaking, and to become a missionary to New Zealand. Mr. Marsden was ordered by the Government to return in the ship "Ann," and, after being on board a few days, found there a sick Maori named Tuatara, who having been buffetted about from one whale-ship to another for some four years, was now trying to get back to his wife and family in New Zealand. He turned out to be a nephew of Te Pahi, and a denizen of the same place. This gave Mr. Marsden a further opportunity of increasing his Maori learning, of which he was not slow to avail himself. This he could do with more effect, as during his voyages Tuatara had picked up a good deal of English. Mr. Kendall did not accompany Mr. Marsden, but two other persons did so,—Mr. Hall, a builder; and Mr. King, a shoemaker, both under engagement to the society. The former, I believe, married just prior to sailing, and brought out his wife with him.

On the arrival of their ship at Sydney, in February, 1810, they were met with the news of the massacre of the crew and passengers of the ship "Boyd," in Whangaroa Harbour. I dare say that many of you have heard the story, still as it may be unknown to some, and the event bore materially upon the train of affairs which I am now narrating to you, I feel that I am not digressing in giving a brief account of the matter as it has come to me, partly from a participator in it.

Captain Thompson, of the ship "Boyd," of some 500 tons, fell in at Sydney with two Whangaroa natives, and as his ship was bound home with some passengers and but little cargo, gladly acceded to their suggestion of calling at that place for a quantity of spars, which they undertook to procure for him; they themselves agreeing to work their passages down. In the course of the voyage, one of these natives, Hori by name, being ordered by the captain to do some work aloft, made the

excuse that he was sick, and being threatened with a flogging if he continued his refusal, pleaded that he was a chief and should not be so treated. Flogged he was though. The ship arrived safely at Whangaroa, the natives were allowed to land, and next day returned on board to take the captain to see the spars; meanwhile Hori had told his people of the indignity put upon him. Captain Thompson, with two boats' crews, were guided by the Maoris some five miles from the ship up the Kaeo River, and after landing were led into the kahikatea bush which grows near the banks. An onslaught was made upon them, and every man slain. The natives, after putting on the sailors' clothes, pulled down in the dusk to the ship, which they surprised—Hori answering the sentry's hail—except some few sailors, who took refuge in the rigging, a Mrs. Morley and child, a girl named Braughton, and the cabin boy. All on board were ruthlessly killed that night; the sailors were shot next morning; but the other four, who had shown compassion towards Hori after his flogging, were spared. They were afterwards given up to a party of Bay of Islands natives, of whom Tamati Waka was one, taken over thither, kindly treated, and put on board the first vessel bound for Sydney.

Altogether seventy souls belonging to the ship perished in this sad affair, but more lives yet were lost in consequence of it. Unfortunately for himself, Te Pahi was at Whangaroa when the tragedy took place. He subsequently asserted that he was altogether ignorant of the attack at Kaeo, having been at a distant part of the harbour, but hearing of the capture of the vessel, went on board, and did his best to prevail upon the natives to spare the surviving sailors, but without avail, and thereupon returned disgusted to his own place at the bay. The tidings quickly spread, and reaching the captain of a whale-ship lying at the bay, he at once put to sea. Shortly after, falling in off the coast with several other ships, the crews, upon hearing the news, determined upon revenge, and learning Te Pahi had been at the scene of slaughter, manning their boats, pulled in at night and attacked a *pa*, situated on a small islet opposite to Rangihoua, in which Te Pahi usually lived. Except Te Pahi himself and one other man, every native in the *pa* was killed, and these two were wounded, the former whilst swimming ashore being struck by a musket ball fired at him by a lad who was keeping one of the boats. Te Pahi died from the wound within a year, and thus Mr. Marsden lost his most powerful and trusty supporter. It seems probable, judging from the partiality shown by Te Pahi to the *pakeha*, that his story was the correct one, and that he suffered owing to the similarity of his name to that of Hori's brother, Te Puhi, who undoubtedly was one of the ringleaders in the bloody affair; but it is certain

that Te Pahi's people participated in the plunder of the ship, for some was found in his *pa*; earrings were made of dollars captured in the "Boyd," and being worn far and wide among the natives served for years after as memorials of the catastrophe.

The destruction of Te Pahi's people was not the only retribution received by the natives, as twenty-one were blown up by the explosion of a quantity of gunpowder, which, having been accidentally wetted, they were drying on one of the ship's sails. The only survivor of that party narrated that, whilst they were all sitting round the powder, one stated that it was dry enough, another contradicted him, and, after a few words more, threw the ashes out of his pipe into the powder, and thus put the dispute to the proof; the survivor, though blown up, escaped by falling into the water.

A figtree on the bank of the Kaeo, near Mr. Nisbet's house, used, in my time, to mark the site of the *hangi* in which Captain Thompson and his boats' crews were cooked. A fragment of the "Boyd" and one of her guns are in our Museum. Another gun is in the crater of a volcano at Pakaraka. I have seen at low water some of her timbers in Whangaroa Harbour, though the upper works of the ship were accidentally burned.

Of course this sad business entirely disconcerted all Mr. Marsden's plans. Tuatara he took to his own house, keeping him there some nine months, (as at first a Maori was hardly safe in Sydney streets), when he left, pledging himself to come and fetch Mr. Marsden and party whenever it should be safe for them to live in New Zealand. Messrs. Hall and King went to work at their trades, and did well. Mr. Kendall's departure from England was countermanded for a time. Matters continued in abeyance for a couple of years, when, the excitement provoked by these unfortunate incidents having been allayed, Tuatara, who had succeeded to Te Pahi's authority, thought the white men would be safe, and shortly afterwards came over himself to escort the party. By this time Mr. Kendall and family had arrived at Sydney, and after a consultation it was determined that a small vessel should be chartered, in which Messrs. Kendall and Hall could make a voyage to New Zealand with Tuatara, ostensibly upon a trading speculation, but with instructions to carefully observe the disposition of the people, and also to induce a few leading natives to return to Sydney with them. The voyage was prosperous, and a favourable report of the Maori disposition towards their *pakeha* visitors put fresh life into their projects. Tuatara and two companions gladly availed themselves of this chance, and as in his several voyages Tuatara had now learned a good deal of English, he was employed in teaching the future missionaries something of his language. One of Tuatara's comrades on this voyage was

Hongi, who some years afterwards became notorious or illustrious by the bloody wars which he waged throughout the Northern Island. It has been computed that 30,000 lives were lost during his campaigns. These did not commence till 1820, after Hongi's return from a journey to England, during which he acquired a considerable stock of arms and ammunition; to the Mission, however, he always proved a staunch friend.

It was not until November, 1814, that the expedition was fully equipped, and the brig "Active" sailed from Sydney, carrying "our earliest settlers" to this country. The ship's company of nine had among it two Maoris, and as many South Sea Islanders, whilst the passengers, besides Tuatara, Hongi and Korakora with five other Maoris, were Mr. and Mrs. Hall and child, Mr. and Mrs. Kendall and three children, Mr. and Mrs. King and one child. This child, Philip, was in after years Clerk and Interpreter to the Resident Magistrate's Court, at Waiuku, and died there a year ago, having been the last survivor of the "Active's" party. These three families formed the Mission Staff; three assigned convict servants were allowed by the New South Wales Government to be allotted to them. There were on board besides, Mr. Marsden himself, a Mr. Nicholas, and Thomas Hansen, the son of the captain. These three returned in the "Active" to Sydney, but the last, Hansen, who was Mrs. King's brother, came back to the Bay of Islands with a young wife early in 1815, and from that time till his death, not ten years ago, at the age of eighty-nine, never once again left the bay.

After calling at the North Cape, the vessel anchored amongst the Cavalli Islands. There Messrs. Marsden and Kendall with the chiefs landed, and met Hori with a war-party of two hundred men. They passed their first night ashore with the people who five years before had killed and eaten the "Boyd's" crew and passengers. True they now had the three chiefs with them as protectors. On the 19th December, 1814, the "Active" reached the Bay of Islands and came-to in front of Rangihoua.

It is hardly possible for any person who has landed in New Zealand during the last twenty years to form a correct conception of the habits and numbers of the natives even twenty years further back; but Auckland early settlers can call to mind the mat-clad people who hawked about fish, potatoes, etc., and the incessant going to and fro of canoes, some even still retaining their quaint *raupo* sails; but then the Maoris all professed Christianity, and intertribal wars had all but ceased; the pakeha too had become numerous, though not sufficiently so as to have the effect of overawing the aborigines. But can any of us picture to ourselves the state of affairs existing when "our earliest settlers" landed? In the first place the Maoris were four or five times more than now, the population in the north especially being very dense. Every hill-top, peninsula, or small island, was

converted into a *pa* as a place of defence not only against strangers, but perhaps from its nearest neighbours: the men were all regularly trained to fight, made to run, wrestle, paddle so as to be in active condition, taught the use of weapons for both offence and defence; in short war was their delight, and any cause however trivial was eagerly sought as an excuse for waging it; the slain were almost invariably cooked and eaten.

The Europeans with whom they had come in contact were not of a class calculated to make themselves either loved or respected, a few run-away sailors or convicts being the only whites living on shore; whilst the treatment which the natives received from the masters of whaling or trading vessels, when powerful enough to get their own way, may be gathered from the terms of the instructions of Governor Macquarie, when he appointed Mr. Kendall the first Resident Magistrate in New Zealand, in November, 1814:—"Whereas it has been represented to His Excellency the Governor that commanders and seamen of vessels touching at or trading with the Islands of New Zealand, more especially at the Bay of Islands, have been in the habit of offering gross insult and injury to the natives of those places by violently seizing on and carrying off several of them, both men and women, and treating them in other respects with injudicious and unwarrantable severity, to the great prejudice of the fair intercourse of trade, which might otherwise be productive of mutual advantages." The same instructions also declared that no sailors should be discharged or left behind at the bay, or natives shipped thereat, without the written consent of one of the three chiefs Tuatara, Hongi, or Korakora. Between bloodthirstiness on the one side, and lawlessness on the other, what slight prospects existed of peaceful relations for defenceless immigrants!

Our "settlers" brought with them sheep, cattle, horses, goats, poultry of all kinds, tools, seeds both for their own use and for their new friends. The chiefs on board, too, had a horse or cow apiece, so that landing and securing their live stock became their first care. *Raupo whares* were put up for themselves, and another set apart for their goods; two of the assigned men were sawyers, the third a smith, and the Kawakawa natives having engaged to fall logs for building the projected houses and church at Ohi, (which was in close proximity to Rangihoua), and also for cargo for the brig, an excursion was made in her to the Thames by Mr. Marsden.

Trouble soon began, for though the native men were only annoying by their curiosity, the women, who even then were not famed for virtue, caused a jealous feeling by their attempts at over-intimacy. The "Active," with Mr. Marsden and Mr. Nicholas, left at the end of February, with a good

many logs,—kahikatea, I should think, from the place at which they were cut; and as her speedy return was anticipated, several natives took passage by her. She conveyed back to Sydney also five runaway convicts (four men and one woman), who had, escaping the search of the Sydney police, managed to find their way to New Zealand as stowaways. Two of these men had been some months among the Maoris in a state of semi-starvation, and voluntarily gave themselves up; the other three arrived whilst the "Active" was at the bay, and were handed over by the master of the vessel in which they had come. One stowaway had been found on board the "Active" herself, but he made his escape into the bush, and was afterwards the cause of much annoyance to our settlers by endeavouring to prejudice the people against them.

Two notable events occurred prior to the "Active's" sailing, which I must not forget to mention: the birth of the first white child, Mrs. King's second boy—he died in infancy; the other the purchase on behalf of the Church Mission from a native named Kuna of 200 acres of land situate between Rangihoua and Tepuna. This was intended to be a model farm, from which, whilst the Mission establishment would provide themselves with needful food and pasture for their animals, the Maoris might learn more ready and profitable modes of culture than then in use amongst them, the *ko*, or wooden spade, being a very inefficient implement. They already had tried to grow wheat and maize, but in very small quantities, having no means of grinding or dressing the grain, and, therefore, being unable to utilize the produce for food; steeping it was a later idea.

The native chief Tuatara, at whose settlement the Mission had been located, was seized with a violent fever and died a few days after Mr. Marsden sailed. This was a serious matter for our new folk, as their other two friends, Hongi and Korakora, then lived respectively at Waimate, and at Paroa on the south side of the bay. Tuatara's brother became nominal chief of Rangihoua, pending the majority of a daughter of Te Pahi, but he wanted both the power and inclination to protect the new comers efficiently.

The "Active" came back in May; the captain's son, Thomas Hansen, who was Mrs. King's brother, had married at Sydney, and brought his bride with him to settle down, but not as a member of the Mission. I knew both these people well. A daughter, born to them in the following year, married the master of a ship, (Capt. Lethbridge), and when left a widow returned to the bay, where she yet resides, the first-born white of this colony as well as its earliest surviving resident. She has been for years a grandmother, and ere this may have seen a further generation of descendants.

Two mistakes were made at the first establishment of the Mission; the site chosen, and the mode of support. Ohi, close to Rahigihoua *pa*, was the beach from which all Ngapuhi war-parties setting forth southwards took their departure, and to which after their expedition they returned. On these occasions many hundred natives from various parts of the north were congregated together in a state of excitement and frenzy, subject to no control; even the people of the place itself at such seasons became utterly wild.

I have already said that the Church Missionary Society only voted £500 a year for the maintenance of its youngest child. This obviously was too small a sum for maintaining three families, and for also providing means of communication with Sydney. To supplement the manifest deficiency, trade was to be resorted to. This would have been well enough had it been confined to merely purchasing for nails, fish-hooks, axes, blankets, etc., such pork and potatoes as were needful for local consumption; but Mr. Marsden's scheme went further: the missionaries were to employ their blacksmith in making implements as barter for flax and for pine logs, which the sawyers were to cut up. After the settlers' own requirements had been satisfied, the remainder was to be shipped for sale, the profit made to go to the Mission funds. This procedure on the part of our friends rendered them obnoxious to masters of trading vessels bent upon a similar errand, who did their best or worst to depreciate them in the esteem of the Maoris, whilst the Maoris themselves, more eager to procure arms and ammunition than more useful goods, could not understand why people trading in one article would not deal in another. This class of trade had been expressly prohibited by instructions from home. The profits made by this sort of business were so large that one of our three first settlers was tempted to enter into it surreptitiously on his own account, and being detected, was expelled from the Mission. Another cause tended after a time to make the party unpopular—their very properly inveighing against the immoralities practised by the crews of vessels frequenting the bay. Many of the chiefs derived large gains from this nefarious business.

Although at first and for some months our settlers suffered no further annoyance than was caused by the inquisitiveness and filth of their visitors—their dwellings being thronged from daylight to dark by guests who left too much insect life behind them—yet matters soon grew worse. Natives coveted some of the *pakeha's* possessions, and when begging failed, occasionally force was resorted to, though sometimes successfully resisted. Then their place was made *tapu*, and no one could deal with them, so that they were nearly starved out; once being rescued from this fate by the accidental arrival of a ship. Mr. King has been obliged to barricade his

house, whilst hundreds of infuriated savages danced a war-dance in front. Next he had his cattle killed. The wretched slaves brought from marauding expeditions were killed and cooked as near as possible to his house, the heads placed upon, and the viscera thrown over, his fence. At one period he attempted to rescue these unfortunates by exchanging them for blankets or axes, but he found it impossible to provide for them afterwards; besides which the natives imposed upon him by making the necessary fire, shouting and yelling over the bound body of a young girl, as if just about to immolate her, and when his feelings of humanity were so wrought upon that he could not refrain from redeeming the captive at the cost of nearly his last blanket, he found himself jeered at,—the pretended victim being one of their own people.

The most powerful chief in near proximity to them was Tareha, after whom the eastern branch of the Kerikeri estuary, known on the charts as Mongonui, was usually termed by old settlers "Tareha's River." This man was a monster both in size and cruelty. I never saw him, but knew well his son and successor Wi Kingi Tareha, who, when he first paid me a visit, came crawling on his hands and knees, his legs refusing to bear the weight of his body. On a later occasion, when he wished to point out the site of a piece of ground near Russell which I had been instructed to have purchased, though he had only half a mile of nearly level ground to traverse, he used two stout young fellows as human crutches, one under each arm. In height he stood between 6 feet 1 inch and 6 feet 2 inches, and weighed about 36 stone; yet I am told that he was a mere chicken to his father, who, having upon one occasion been hoisted on board a whale ship, after having devoured a leg of pork and drunk a bucket of the cook's slush, consented, for a consideration in tobacco, to allow himself to be weighed. A seat was fitted for him, and, the steelyards having been attached to a tackle, he was raised up; but, alas! ineffectually, as the steelyards were only graduated to 600 lbs., and were inadequate to perform the requisite operation. I have heard many wonderful stories of his voracity, but of his cruelty I had one from an eye-witness. Tareha was sitting on a large stone with a small fire in front of him, when he called for some water; the calabash was empty, and, as he only drank water from a spring a mile away, he told a woman near to fetch some. She made the excuse that she was nursing a child. "Give it to me," said the savage. When the woman returned with the water the monster was munching the arms of the child, which, after dashing upon the stone, he had frizzled upon the fire before him.

To escape some of their miseries the members of the Mission got houses built at Tepuna on the land which they had bought, and where Hohaia

Waikato, who shortly after went to England with Hongi, gave them his protection. This old chief was one of my assessors, and was alive till within a very few years ago.

The Mission was strengthened in 1819 by the advent of Mr. Kemp and party, and in the following year Hongi on his return from England gave them a site at the head of the Kerikeri, near his own new *pa*, on which more permanent buildings were erected, and for some years constituted the head-quarters, though Mr. King always resided at Tepuna; and one of the Hansen family is, I believe, living there now.

I believe that Messrs. Kendall and Hall have left no representatives in this colony. King and Hansen had large families. I have known four sons and as many daughters of the former, of whom six still survive, but I think that there are only five or six of the next generation, and not very many of the fourth; but the descendants of the Hansens must by this time reach close upon, if they do not extend beyond, 100 in number. Although some of these have moved to other countries, by far the majority remain in the land in which their ancestor was one of the earliest settlers 68 years ago.

Good cause have we pakehas to be proud of those intrepid men, who, not in the hope of any earthly gain, ventured not merely their own lives, but those of their wives and children amongst a multitude of truculent savages; who for years endured every species of anxiety and misery; who, by patience and perseverance, converted the natives to, at the least, nominal Christianity with its concomitant civilization, and thus commenced paving the way for New Zealand becoming what it now is—a safe and prosperous dwelling place for so many thousands of our race.

On the other side, the Maori one, as to the effects of European civilization upon their people, hear what an old chief replied to my question: "Suppose white people had never come here?" The aged warrior paused, and then apostrophized:—"I see an old man standing on the look-out post of lofty Te Ranga's vacant *pa*. He strains his eyes, peering in every direction, no sign of human being, no uprising smoke meets his gaze, and thus he cries to himself: 'nobody, nobody, not one, alas, not one! Days have passed since last I tasted the sweetness of human flesh; is it all finished? One thing at least—no one survives to consign my body to the *hangi*.'"

Art. LIV.—*Historical Traditions of the Taupo and East Coast Tribes.*

By Samuel Locke.

[*Read before the Hawke's Bay Philosophical Institute*, 14*th August and* 9*th October*, 1882.]

Part I.

At the request of many friends, some of whom are members of this Institute, I have consented to read from time to time translations of traditions, principally historical, of the Maoris, collected by myself during the past twenty years.

It is my intention to adhere as near as possible to a literal translation of the legends as written by the Maoris themselves, believing, as I thoroughly do, that the time to generalize has not yet arrived. That must be left to *savants* for time and the necessary accumulated information derived from all sources to act upon; but in the meantime every exertion should be used from all quarters to recover the records of the Maori past. Most of the traditions I have in my possession were written by the Maori priests themselves more than twenty years since. To give an example of the time and trouble required in collecting this kind of information I would mention that I have just received some books that I left seventeen years back with old chiefs to write in as they felt inclined. To talk is an easy matter with the old Maori, but to write is a great labour. Besides, many of the incantations, etc., are so sacred in *their* idea that they could not be repeated in a common dwelling-house, but had to be written in the open air, as there are no *tapu whares* now. To show to what a late period the heathen practices were carried on and these sentiments prevailed,—I am aware that, at the Wairoa, in 1865, in a sacred *whare*, incantations, etc., were gone through in the presence of "Kahukura," a Maori god, the principal object being to inquire into the success or otherwise of the Hauhau movement that was then going on. But few natives are now alive who were at that meeting. I have tried hard to obtain the image of Kahukura since that time, but the old men hid it, and it is not known where. The old Maori priests who were at that meeting attended church regularly. Some of the ancient ceremonies I found to be still carried out amongst the Tahoe or Urewera at Ruatahuna on my last visit to that district in 1874. I have been present at other meetings of the kind above mentioned, but never a more earnest and sincere one.

In the course of my papers I must from time to time repeat parts of legends previously related by Mr. Colenso, and printed in the Transactions of the Institute, that gentleman having on various occasions used exactly the same words which, in giving the whole story, I shall be obliged to recapitulate.

I shall commence with the traditions of the Taupo district, and on a future occasion will follow up with matters connected with Hawke's Bay, the East Coast, and other parts of the country, and with older traditions or myths. I am one of those who firmly believe the Maori has occupied this country for a more lengthened period than is generally supposed, and that their traditions go far to prove that the country was inhabited long before the arrival of the much-talked-of canoes, viz., Te Arawa, Tainui, etc. Supposing the Saxons had asked the ancient Britons if they were the aborigines of Britain, no doubt the answer would have been in the affirmative, and such was the universal opinion until lately. But now Sir C. Lyell, Professors Dawkins and Flowers, M. Quatrefages, M. de Mortillet, and many other men of science, have clearly proved that mankind roamed over our native country for, perhaps, one hundred thousand years before the arrival of the Celts, and probably for double that period, in fact for untold ages, and not a relic of their existence remains except a few bones and rude stone axes. But to proceed.

Historical Traditions of the Taupo and East Coast Tribes.

The names of the earliest Maori inhabitants of the districts of Taupo and Heretaonga (Hawke's Bay) were :—At Taupo, Hotu and Ruakopiri ; at Patea, Whitikaupeka ; at Kaimanawa, Te Orutu and Tuhiao ; at Runanga and Urewera, Te Marangaranga ; at Upper Mohaka, Te Maruwahine ; at Heretaonga, Te Whatumamoa, Te Koaopari, Toi, Tane-nui-arangi, and Awa-nui-arangi.

Ko Hotu and Ruakopiri.

The people who first occupied Taupo and the surrounding country were Hotu and Ruakopiri, and they considered the district for ever theirs. Hotu and Ruakopiri, it is said, came to Taupo by way of Waikato and the north. Kurapoto and his followers are said to have arrived in the Arawa canoe, and travelled across from the Bay of Plenty.

On reaching Taupo, Kurapoto* found the country fully settled by Hotu and Ruakopiri. Fighting commenced between the two parties, and Kurapoto drove the Hotu to the upper end of Taupo Lake; then peace was made by Kurapoto, and the two people thenceforward resided together in the lake district. The remnant of these tribes still point out Taupo as theirs.

Ko Tia.

This is an account of one of our ancestors who came in the Arawa from Hawaiki, and travelled to Taupo. It is through Tia the present name of

* If Kurapoto, who is said to have arrived in the *Arawa* canoe, found the Taupo country filled with people, where could those people have come from, if no earlier migrations took place? For tradition says the Arawa and Tainui, and the other canoes named, arrived about the same time.

Taupo is derived. It is so called from the place where he slept, near a small waterfall over a projecting rock on the east side of the lake, viz., Taupo-nui-a-Tia; perhaps he slept or rested there long at night.

After the Arawa landed at Maketu, Tia and Maaka travelled by way of Kaharoa, Rotorua, Horohoro, Whakamaru, Titiraupenga, and round the west side of Taupo—the side next to Waikato. They did not return to Maketu, but died near Taupo at Titiraupenga. Their skulls have been seen by this generation carried to the *kumara* grounds that the crops might be plentiful, a custom which is of very ancient date with the Maoris. This is all about these ancestors.

Tia's descendants reside at Taupo. All the great men of the district trace their genealogies back to him nineteen generations:—

Tia, Apa, Tamaapa, Tamaaia Tamaariki, Tamatatonga, Tatekura, Tuahatana, Takapumanuka, Kahupaunamu, Taimeneharangi, Hiko, wife of Tamamutu (grandson of Tuwharetoa) Kapawa, Meremere, Rangi-tua-Matotoru, Rangihirauea, Tumu, Maniapoto—in all nineteen generations.

Te Heuheu, Hare Tauteka, and the other chiefs, go back to the same ancestor in their genealogies.

Ko Ngatoro-i-rangi.

This is an account of one of our renowned ancestors who visited the sea of Taupo and the open country, the forests, and the plains around. He came to this island from Hawaiki in the Arawa canoe, which landed first at Whanga-paroa (near East Cape), then sailed on to Whakatane and Maketu. After Ngatoro-i-rangi had resided on the coast for a time he travelled inland by way of Kanakaua, Ruawahia, Te Puna-takahi. After crossing the Kaingaroa plains he reached Tauhara Mountain, which he ascended, and from thence looked down on the Sea of Taupo and at the snow-capped Tongariro in the distance. From the top of Tauhara he threw a large tree into the lake, a distance of four miles, which is still to be seen by this generation; it is sticking up at the bottom of the lake near Wharewaka. The name of Ngatoro's spear is the "*kuwha*." Ngatoro-i-rangi then descended to the shores of the lake, near the Waipahihi, and performed incantations, and erected a *tuaahu* and named it Taharepa. When he discovered there were no fish in Taupo Lake he scattered the threads of his mat on the waters and performed religious rites, and the lake at once contained fish, viz., the *inanga* and the *kokopu*. He then travelled along the shores of the lake and ascended Tongariro, and was there benumbed with the cold on that snowy mountain. (His companion Ngauruhoe died here from the cold). So Ngatoro commenced calling out to his sisters to bring him fire from Hawaiki, for they had been left behind at Hawaiki. The sound that proceeded from his mouth was like thunder. His sisters heard him and came at once bringing fire.* Their canoe

* See "Nga Mahinga a Nga Tupuna Maori" in Polynesian Mythology:—Sir G. Grey.

was a *taniwha.* The names of the sisters were Kiniwai, Haungaroa, and Pupu-a-te-Hoata. The sisters landed at Whakaari (White Island, Bay of Plenty), and there lit a fire (geyser). They then came on to the mainland at Umapokapoka (a geyser), and then travelled on by the Kaingaroa Plains. This name (Kaingaroa—long at food) was given through Haungaroa being so long over her food at a place named Whakaaweawe, so-called through Haungaroa following some of her companions to chastize them for remarking on her being so long over her meal. They turned into cabbage trees, which are still to be seen by travellers, but they always recede as you appear to approach them. The sisters lit a fire (geyser) at Tarawera Lake, then ascended a hill and looked down on Rotorua Lake; one of them slipped down here, so they called the place Te Hemo, and lit a fire (geyser) there, and then proceeded on to Paeroa and Orakeikoraka, where they lit another geyser, and shortly after arrived at Taupo. But Ngatoro-i-rangi had returned to Maketu, so the sisters determined to join him there. On passing along the Kaituna stream they observed a *totara* tree standing. When they arrived in sight of the *pa* and the people saw them coming they shouted the call of welcome and beckoned them to come to the *pa*, but they declined, at the same time calling out that the priests should be sent to them to perform the necessary incantations to free them of the curse of Manaia. The priests were accordingly sent, and performed their religious rites to free them of the curse.* The sisters then proceeded to the *pa*, carrying with them the gods—viz., Rongomai, Kahukura, and others which they had brought with them from the sacred places where Ngatoro-i-rangi had left them. Enquiries were then made for news from Hawaiki. The sisters informed Ngatoro-i-rangi that they had all been cursed by Manaia. Ngatoro enquired the nature of the curse and the cause thereof. They replied Manaia had cursed Ngatoro-i-rangi saying, "Are the logs in the forest as sacred as the bones of your brother that you are afraid to use them in cooking, or are the stones of the desert the kidneys of Ngatoro-i-rangi that you do not heat them? By-and-bye I will frizzle the flesh of your brother on red-hot stones taken from Waikorora." The cause of this curse was that Kuiwai, Ngatoro-i-rangi's sister, and wife of Manaia, had not thoroughly cooked the food at a great sacred feast at Hawaiki.

Ngatoro-i-rangi, at hearing this, was much cast down; the cause of his vexation was, he had no canoe with which to pass to Hawaiki to enable him to destroy the hosts of Manaia, as the Arawa had been burnt to ashes by

* Another version of this tradition says that when the sisters arrived at Maketu after their inland excursion they at once entered the *pa* by climbing over the fences and then seating themselves on Ngatoro-i-rangi's sacred seat, and that they were afterwards cleansed by the priests from the curse of Manaia.

Raumati. The sisters then related that they had seen a *totara* in the Kaituna Stream. Early on the following morning all the people set to to dig up the *totara.* They did not fell the tree as they had no axes, so they dug it down and launched it with branches and roots on, which departed seventy twice told (*hokowhitu*, 140). It was by incantations and the help of *taniwhas* that canoe was propelled. Its name was Totara-Karia (the *totara* dug from the earth). The party landed safely on the other side (*Hawaiki*). The *tohungas* then instructed the people what to do. They said, "you must strike your noses until the blood runs"—*me titoia nga ure*—so they might look like dead men brought there. The people then gave severe blows on their noses, which caused the blood to flow freely. They then lay down on the beach, scattered, as it were, near the sacred places, hiding their weapons under them. The *tohungas* retired to the *tuaahus*, sacred places of augury, to perform their incantations. At the dawn of the morning the people of the *pa* came down to the beach, and seeing the apparently dead men scattered about, they shouted out, "Here is a work, men scattered all over the beach, sent by the gods; see, they are in our midst." The incantations had done their work. When the people of the *pa* had all collected on the beach, up jumped the war-party and attacked them. The fight was severe, both sides being numerous. The people of the place retreated to their *pa*, but many were killed. The *tohungas* then performed incantations over the dead to take off the *tapu.* After that they were cooked and eaten. Feasting was hardly over when the people of the *pa* made an attack and fighting commenced again, but they were repulsed a second time with great loss, and their *pa*, named Whatiri-ka-papa, taken. The name of the battle, which was fought in the morning, was called Thumotomotohia. The *pa* was taken on that day, and many of the *rangatira* killed. Ngatoro and party then, after making proper offerings to the gods, returned and landed at Maketu and Motiti. Ngatoro-i-rangi lived at Motiti.

A short time after this the people of Hawaiki, led by Manaia, came to seek revenge for their losses. Their party was very numerous both in men and canoes. They arrived off the island Motiti, in the Bay of Plenty. The old man, Ngatoro-i-rangi, was residing there alone with his wife, his people being all at Maketu. The whole ocean appeared to be covered with the hosts from Hawaiki. The voice of Ngatoro-i-rangi was then heard calling out, "Stay out there for the night, in the morning we will fight when the sun will reflect the glittering of our weapons." The host agreed to this, and cast out their anchors into the water. Ngatoro-i-rangi then hastened to his *tuaahu*, and performed his incantations and auguries, and called on the winds of heaven, named Tawhirimatea, Pungawere, and Utupawa; then came the rushing sound of the howling winds. The foam of the raging

ocean was like sand-clouds of the desert in a gale. All were destroyed—the great host of Manahua were engulphed in the ocean—none escaped. That people were utterly destroyed, and the destruction was called Maikukutea. Thus were the people of Hawaiki destroyed by those of this island, and the curse of Manaia avenged.*

This ends the story of Ngatoro-i-te rangi. That *tohunga* was the chief priest of the Arawa when they sailed from Hawaiki. From him are descended the people of Taupo, viz., Tuwharetoa and Aopouri, twenty-five generations.

[1]Ngatoro-i-rangi, [2]Tangaroa, [3]Tupai, [4]Irawitiki, [5]Kiwi, [6]Kakeroa, [7]Rongo-mai-nui, [8]Rongo-mai-roa, [9]Rongo-mai-a-pehu, [10]Apehumatua, [11]Mawakeroa, [12]Mawake Taupo, [13]*Tuwharetoa*, [14]Rakeihapukia, [15]Taringa, [16]Tutetawha, [17]Rangiita, [18]Piungatai, [19]Mahuika, [20]Poinga, [21]Tumaro, [22]Whatupounamu, [23]Tauiteka, [24]Hare Tauteka, [25]Matini Tauteka. So also do the Poihipi, Heuheu, Hohepa, and other chiefs go back to Ngatoro-i-rangi and Tuwharetoa in their genealogies.

Ko Tuwharetoa.

The following is an account of Tuwharetoa, a renowned ancestor, after whom is named the tribe possessing the country around Taupo and Rotoaira Lakes, the mountains of Tongariro and Ruapehu, the rich Patea, Kariori, Murimutu, Kaingaroa and Okahukura plains.

Tuwharetoa, of Aripouri, was an Arawa, and lived at Tamarakau, at the Awa-o-te-atua and Kawerau. He was renowned as a warrior, and had fought the tribes living on the coast; and, having subdued them, had returned home and hung up his weapons in his house. He and his people, together with those of Tutewero, son of Maruka, having made the neighbouring tribes to fear them.

After a time it occurred to Hatupere to fight with Tuwharetoa and Tutewero. Now Tuwharetoa was living at peace with his wife, Hineuotu and his children,—some ten or twelve,—at Kawerau, and was quite ignorant of the attack on Tutewero. Hatupere and the Marangaranga were defeated and fled towards the Whaiti and the mountains dividing Taupo

* That Ngatoro-i-rangi and his one hundred and forty picked men afterwards went to Hawaiki, as stated, and landed at Tara-i-whenua, and that he then consulted with his sister Kui-wai, and from her learned the movements of the people, by which means he was enabled to lay his plans: and that, after the capture of the *pa* Whaitiri-ka-papa, and the proper incantations and offerings had been made to the gods, another battle took place, called Tarai-whenua-kura, in which Manaia was defeated, and that then Ngatoro-i-rangi and people returned to Maketu and Motiti, and the battle of Taiparipari and Maikukutea occurred,—*vide* Sir George Grey's "Polynesian Mythology," "The Curse of Manaia," English translation, for the full account of this and many other interesting traditions.

Plains from Heretaonga (Hawke's Bay). When Tuwharetoa and his sons heard of the fight which had taken place, and that Hatupere was defeated, they felt ashamed (sick with shame) about the battle of Tutewero.

Then arose the army of the sons of Tuwharetoa, Rakahopukia, Rakeipoho, Rakei-makaha, Taniwha, and Rongomai-te-ngangana. Their sons, the grandchildren of Tuwharetoa, went also. They pursued and overtook the enemy at Kakatarae, near Runanga, where a battle was fought with Marangaranga.

The children of Tuwharetoa were beaten. That battle is known as the battle of "Kakatarae." Rakeipoho, Rongomai-te-ngangana, and Taniwha were the chiefs killed here. The women were taken prisoners by Marangaranga, and one hundred men killed and one hundred and forty left alive. Tuwharetoa retreated to the Ahi-o-ngatane (where Taupo road emerges on the plains near Runanga). They there caught a *kiwi* and killed it, and offered one half to the gods and one half to Papanui (a religious ceremony connected with war). Takatore was the name of the priest of the party who directed these things to be done. They slept there, and in the morning they marched forth and surprised the enemy, who were cooking a man for food. They rushed them, and defeated the Marangaranga at Rarauhipapa, and captured all the women of that tribe and killed perhaps two hundred men.

The old man Tuwharetoa was residing at Kawerau all this time. The killed were carried to Hinemaiaia on the shores of Taupo Lake. The party then proceeded along the shore by Maniaheke and the Kowhaiataku, and on arriving at the point at Umu-kuri they blew the *pukaea* (a trumpet made of wood bound together, about five feet long) as a signal to the Ngatikurapoto living at Rotongaio. When the woman named Hine-kaho-roa (a priestess) heard the sound, she went mad with rage, and called out the curse "Pokokohua-ma" (a Maori curse signifying mummified heads).

When the sons of Tuwharetoa heard this curse they continued to blow the *pukaea*, thus:—*To-roro-to-roro*, thy brains, thy brains. Then called Hine-kaho-roa, the priestess, and said, "I will liken my fern root to the bones of your ancestors Rangitu and Tangaroa." Then were the hearts of those people dark, and they said, "Why abide here to be put in kits of *toe-toe*." So they marched off to the coast, to the *kainga* of Tuwharetoa, and told him they had been cursed by the Ngatikurapoto, and that the fernroot of Hine-kaho-roa had been called the bones of Rangitu and Tangaroa. The old man was very sad, and went straightway to the auguries that the curse might be put off him and fall upon the woman.

In the morning the sacred army, which had been sent for by Tuwharetoa, arrived from Puehuehu, near Tarawera-moana, and a lizard was killed by them, by which means the curse passed off. The army then returned to their home, where they waited perhaps ten nights, and prepared food.

Then said Tuwharetoa, "Go kill the Ngatikurapoto." The army then started and marched on till they reached Waikato and on to Takapau. There they divided into two parties, one going by way of Aputahou, Tauhara, on to Waipahihi, Wharewaka, and so on to Rotongaio. On the day of their arrival they killed Kurimanga, the priest, and cooked him in an oven, from which circumstance the place is called Umu-kuri.

They slept there that night, and next morning attacked two *pas*, both of which fell into their hands. The names of those *pas* were Tara-o-te-Marama and Pa-powhatu. Some were killed, and others saved. Those of that tribe who were spared went to live on the plains in the direction of Heretaonga (Hawke's Bay). The army then proceeded along the shores of Taupo Lake.

The other division of the war-party had gone by the plains and arrived at the Kotipu without meeting anyone. They there smelt a fire, and, on searching, found a woman named Monoao, whom they killed as a sacrifice to the gods. The chief of the party which went by the plains was Rereao. The other chiefs were with the party which went by Taupo. Their names were Taringa, Waikari, Patu-iwi, and many others.

The party under Rereao marched on to Tuariki and descended to Tauranga (on the shores of Lake Taupo), where they found the Ngatihotu living. They killed Tara-o-te-Marama and made a prisoner of Kurawaha, a chief of Ngatihotu, at Kanihinuhi. When Ata-iwi-kura, daughter of Rereao, saw what a fine man Kurawaha was, she saved him and took him unto herself as a husband.

When Rereao and party had made an end of staying at Tauranga, they proceeded by way of Onemararangi. The Ngatihotu were collected at Kakapakia. That *pa* was then attacked and the people to the number of two hundred were killed. An oven was at once dug by Rereao, and one hundred and forty were put into that oven. They hung up Tipapa-Kereru, the chief of the *pa*. Rereao's killing of men ceased here. He then went about the country making landmarks (taking possession). The saying, "The long oven of Rereao," has been handed down to this generation.

After this he and his party proceeded to Motiti, the Kotuku-o, Rereao, the Kowhiti-o-Rereao, the Pungarehu-o-Rereao, and to Pukawa-o-Rereao. Here they stopped, and here they met the party which had travelled by the other shore of Lake Taupo. The chiefs now decided to proclaim peace, all the

chiefs and all the tribes consenting. A woman was therefore presented to the chief of Ngatihotu named Paepaetehe. The woman's name was Hineuru, sister of Taumaihi of Puteketeke and of Rorotaka. Some of the party then returned to Kawerau, the abode of Tuwharetoa in the Bay of Plenty, and some remained at Taupo.

The district now remained for many years at peace, and the Tuwharetoas considered the country theirs, when it occurred to Ngatihotu to seek revenge by murder for their former defeat and the lives of their relatives killed by Tuwharetoa. The Ngatihotu were then living at Motiti, in the mountainous country of Kaimanawa.

Rorotaka, Puteketeke, Taumaihi, and others of the Tuwharetoa tribe went at that time to Motiti, and were beckoned by the people of the place (Ngatihotu) to enter the *pa*. They did so, and sat down in the house. The inhabitants of the place then put feathers of birds on the oven so that the guests might think from the smell reaching their noses that birds were being cooked for them at the fire. It was only a deceit, for the chiefs of the *pa* (Ngatihotu) had planned to kill Puteketeke, Rorotaka, and Taumaihi. Their sister, it will be remembered, had been given as a wife to the chief of the *pa*—viz., Paepaetehe of Ngatihotu. She was sitting in the house talking with her brothers of the Tuwharetoa quite ignorant of the murderous intentions of her husband and his tribe. The visitors enquired of her what was going on outside, and she answered, "They are preparing some food for you." She then went out to see how things were getting on, when she met the Ngatihotu coming to kill the people. She then cried out, "Sirs, an attack, an attack."

The fight then commenced, the enclosure round the house and the veranda were full of people. Rorotaka stood at the door and Puteketeke at the window with ten others. Rorotaka had a *pukaea* (bugle made of wood). He commenced to jump about in the house shouting and yelling. The people fell back into the enclosure of the village; Rorotaka threw his *pukaea* at them exclaiming, "I will have the heart of the first killed." The people all gathered outside of the house and the fighting then continued between the ten and the three hundred.

Taumaia called out, "Oh! Puteketeke; oh! we cannot hold out any longer, the people are collecting spears."

Puteketeke now observed that Rorotaka was out of wind, so he rushed to the front, and there got stabbed in the thigh; but he did not fall, he continued rushing on while the enemy fell back before him, so he and his party escaped. No chief was killed. Puteketeke alone was wounded, but not killed. They then fled to Whaka-pou-Karakia, and concealed themselves there. Those who were able went on to Taupo.

When Ngatituwharetoa saw them and discovered that they had been beaten, they at once sent round and collected all the people around Taupo. When they were all gathered together, they advanced against Ngatihotu, and a battle ensued. Several were killed on both sides. Ngatituwharetoa then sent Waikari to collect followers from Kawerau, from the Awa-o-te-atua, and from Whakatane. They all came with Tutewero and his people, and brought the god Rongomai with them to strengthen them in battle. They all mustered under Waikari and Tutewero, at Taupo. It was proposed that the people should separate and take different roads, which arrangement was consented to. Taringa was chief of the party which went by Waimarino. Karihi was chief of the party to go by Whakapoukarakia. Waikari was chief of another party, and Tutewero of another. So they all started. Waikari reached the Ngau-i-taua-pa, which was taken and the people killed. The whole district was cleared, and Ngatihotu destroyed. A remnant fled to Tuhua and Whanganui, and so Taupo came entirely into the possession of Tuwharetoa. Nothing was left of Hotu at Taupo, and Ngatikurapoto were totally subdued by Ngatituwharetoa.

After a time another tribe—namely, the descendants of Tamaihuturoa—came and abode at Taupo. The grandson of Tuwharetoa, named Ruawehea, made terms with these people, and they remained as his subjects. The *pas* occupied by these people (the Ngatitama) are called Waihaha and Opurukete.

Ruawehea's residence was called Whakaueuku at Karangahape. When he desired to visit his people he went in his canoe, and on approaching the *pa* sounded his *pukaea* as a warning to them of his coming, in order that food might be cooked for him. His call was, "Prepare food, you pokokohua-ma to-roro-to-roro" (you mummified heads, your brains, your brains).

As soon as he landed food was presented by the people. This was done on all occasions when he visited them. The thought then occurred to the chiefs of Ngatitama, viz., to Rongohape, Rongohaua, and to Atua-rere-toi, to murder Ruawehea. Shortly after this Ruawehea and his slave came paddling to their *pa* cursing as usual. The people then burnt some weeds to induce Ruawehea to think it was food that they were cooking for him. As soon as he landed he was invited to the house of the chiefs Rongohaua, Atua-rere-toi, and Rongohape. These men placed themselves in the following positions in the house :—Rongohape sat at the window, Rongohaua was in the centre of the *whare*, and Atua-rere-toi at the far end. As soon as Ruawehea came near the door, he was invited in. "Come inside, sir," they said. He then entered, and when his head was inside, Reretoi muttered, "Who was the man with Rongomaiwhiti, eh ?" The old man was

then killed, and was carried away and hidden under the waterfall at the precipice. He was not eaten. His slave escaped to the opposite side of Taupo, and informed the Ngatituwharetoa tribe that his master had been murdered. Messengers were at once sent to all parts of Taupo to collect the Ngatituwharetoa for the purpose of utterly destroying the tribe of murderers. In a few days they were all collected together. They then paddled over in canoes to the number of eight hundred men. The brave Waikari accompanied the army, his weapon being a *taiaha*. They paddled to the Whakauenuku, where they landed, and distributed food amongst the several *hapus*. Tumatangana divided the pounded fernroot, and while doing so observed Waikari sitting in his canoe, the reason for his doing so being he had brought no food with him, and felt ashamed. Tamatangana gave him some fernroot, which he did not eat, but stowed it away in his belt.

During the night the army paddled on, and in the morning landed below the *pa* and occupied all the approaches. They then made an attack, and the *pa* fell into their hands. Several people were killed. One chief, Rongohape, who was taken prisoner, tried to escape by the cliff. He descended into the water and came near a canoe, in which a boy named Rangaita and his slave were sitting. The boy seized Rongohape by the head and hauled him into the canoe and killed him. Upon enquiry being made for a chief who could not be found among the prisoners or the slain, Rangaita exclaimed, "I have the man lying in my canoe." He was asked if he was a full-grown man, and he answered "Yes," with a lame leg. The prisoners were then bound and placed with the army.

Waikari took Roroihape, a chieftainess, prisoner, whom he carried away with him. The men all begged for Roroihape for a wife, but Waikari would not consent, as he intended to give her to Tumatangana as compensation for his liberality in having presented him with the pounded fernroot.

The chiefs of Ngatitama who were killed in this engagement, as payment for the murder of Ruawehea, were Rongohape, Rongohaua, Atua-rere-toi, and others. Afterwards another attack was made on the Ngatitama, when the *pa* Purukete fell. From that originated the proverb, "*Aue, mate, he mate wareware te kite au i o Purukete.*" The reason of that proverb was because Ruawehea was not eaten. The remnant of Ngatitama fled to Rotorua and Lower Taupo. Kapawa collected a few of the tribe to reside with him.

That is all in reference to the Ngatitama tribe who were subdued by Ngatituwharetoa. All Taupo became the property of Ngatituwharetoa, who still hold it, and are now living there.

The First Gun in Taupo.

The following is an account of some fights when there was only one gun in Taupo District:—

The descendants of Tuwharetoa are still noted for their bravery; none of the tribes of this island have been able to subdue them. A tribe called the Ngatimaru came to Taupo intent on conquering them. They came at first unexpectedly and took the people by surprise, but were forced to retire. On their second coming all the men of Taupo had collected together on Motutaiko, an island situated in the Sea of Taupo, and there they determined to defend themselves against the Ngatimaru. All the people of Taupo, when they saw that Ngatimaru had come with the full intention of subduing the Ngatituwharetoa, got into their canoes and made for the Island of Motutaiko. At that time only one gun had reached Taupo.

As the enemy appeared on the shore a man in one of the canoes named Ruipawhara fired the gun and killed two of them. They took fright and retired, and in the morning we followed and overtook them at Lake Rotoaira, at the foot of Tongariro Mountain, where a chief named Arakai was killed by Poinga with a *taiaha*. Wharemarumaru, a Waikato chief, was also killed, as well as many others, perhaps two hundred, including women. But some escaped and fled to Hauraki (the Thames) where they gave an account of their defeat. The Ngatimaru had brought a number of women with them for holding the prisoners they expected to take, but having beaten them, we kept their women as slaves for the people of Taupo.

Shortly after this the same tribe returned reinforced, seeking revenge for their dead. They came four hundred strong under the leadership of Honorehua. A battle ensued, and they were defeated. The Ngatituwharetoa had but the one gun, while the enemy were well supplied with such weapons, but what was that to the men of Taupo? They could stab and kill with the *huata* and *mere-mere*, and other Maori weapons. Enough! The Ngatimaru tribe fled, and have never since returned.

Invasion of Ngatiraukawa.

This is another account of a war that occurred after the fight with Ngatimaru:

Another tribe which, in times past, has striven with Ngatituwharetoa was the Ngatiraukawa. The quarrel between them originated through the Ngatiraukawa digging up and taking away the bones of Rangitua and Matataru. Tawei and Hurihia fled naked to the Heuheu and informed him of what had taken place. He then assembled all Ngatituwharetoa and marched to Rangatira, where they encountered the Ngatiraukawa and defeated them, killing about two hundred, including the chief Patana. They

rallied, however, and the fighting continued to rage in Taupo, many on both sides being destroyed; so much so that several of the Taupo people became afraid and fled. Those from Lower Taupo went to the Arawa, Rotokakahi, and Lake Tarawera, others to Tarawera beyond Runanga.

The people who remained to keep possession of Upper Taupo were the Heuheu and his *hapu*, and Tauteka and Rangi-monehunehu with two hundred men of their *hapus*. The name of the *pa* in which they were collected was Whakatara.

The *hapu* which kept possession of Lower Taupo was Ngatirangiita, comprising the families of Matatoru, Hautapu, Tauarai, and Wharengaro. The *pa* in which they collected was called the Tarata. From these *pas*, the only ones held in Taupo, fighting was carried on without ceasing until peace was made. After everything was quiet, those who had fled returned to their former habitations. Thus have the Ngatituwharetoa maintained their *mana* in Taupo.

Part II.

I stated in my introduction to the first part of these readings that I was one of those who firmly believed that the Maoris have occupied this country for a more lengthened period than is generally supposed, and that their traditions go far to prove that these islands were inhabited long before the arrival of the much-talked-of (mythical?) canoes, viz., the Arawa, Tainui, and others, and that in these readings I would confine myself as far as possible to traditionary evidence. The more this question is investigated by an unbiassed mind, the more clear I think it will appear that such is the case; for instance, I would draw attention to the facts set forth in Mr. Colenso's able essay on "The Maori Races"* in the Transactions and the many other articles referring to the Maoris by the same gentleman in various volumes of that work. Again in the "Mythology and Traditions of the New Zealanders," and the "Poetry of the New Zealanders," by Sir George Grey. The Rev. R. Taylor, in his "Ika a Maui,"† shows clearly what his opinion is on the matter. Then we have, in vols. x. and xii. of the "Transactions,"—"Traditional History of the South Island Maoris," by the Rev. J. W. Stack, and the many contributions on the subject by the Rev. J. F. H. Wohlers; and also of Dr. Hector, Messrs. R. C. Barstow, Travers, Goodall, and the important discoveries by Dr. von. Haast and others in regard to the ancient caves and moa-hunters. I might also quote Dr. von. Hochstetter's "New Zealand," in chapters ix. and x. of which volume he argues that Hawaiki and the legendary canoes and migration are all

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* Trans. N.Z. Inst., vol. i.

† "Ika a Maui," 2 ed., pp. 153-4, 258, 290, 291.

mythical; besides numerous other contributors tending in the same direction, and bearing on the subject of "Polynesian Folk-lore," and the comparative philology and comparative mythology of the Polynesian Pacific and Central American races.

I am quite aware that to approach even approximately the period that these islands may have been inhabited by man we must investigate through a different channel than the evidence given in these obscure oral traditions. But let us record them all while the opportunity offers, more particularly for their great value on other branches of the subject of "Whence the Maori," remembering what Mr. Colenso has well said, "That while the details of a legend are always false, the legend itself always contains a kernel of truth;" for it is almost invariably the case that when a legend or tradition refers to an event even of a comparatively recent period it is clouded in mystery and fable often of a most puerile nature.

If we give credit to the accounts given of the voyages, etc., of the canoes, we must also allow the accuracy of the traditions of the subsequent wondrous doings of Ngatoro-i-rangi and his sisters starting the volcanic system of this island and the sinking of the Taupo Lake; the removal of Taranaki Mountain from between Tongariro and Ruapehu to where it now stands at New Plymouth; also the race between the Waikato and Rangataiki Rivers to reach the sea; that Manukau Harbour was once a lake; that an island called "Motukeikei" once existed off the mouth of Manukau Harbour; the severing of the North from the South Island by Kupe; the legends connected with the Waikare-moana Lake; that the Mahia Peninsula was an island; and that the sandy beach which now connects it with the main land was brought from Hawaiki: and later again, the killing of the *Taniwhas*; the travels of Tara and his dog, when Tara dug out the Roto-a-Tara and other lakes about Te Aute; the wonders performed by Rongo Kako, Pawa, Paikea, Ruatapu, and Kupe; the shattering of the mountains around Hikurangi (East Cape) by the two first-named; the removal of Mata-rua-hou (Scinde Island) from the Raukawa Ranges to where it now stands; the removal of the Ariel Rocks off Poverty Bay from Makauri, etc., etc. I would suggest: are not these mythical traditions of great geographical changes that have taken place in this country since it was inhabited by man, thus, indeed, taking us back to the remote past? The genuineness of one account is about on a par with the others.

I will attach some genealogies to this paper, one purporting to show at what period and in what manner the later migrations became amalgamated with the older inhabitants. The other is derived from Papa and Rangi, viz., the commencement of heaven and earth as it now appears. This genealogy takes in Maui, the Maori Hercules, and Tawhaki, who ascended alive

to heaven by a spider's web; also Ruatapu, the Noah of some enthusiasts. I would mention here, in regard to Maui, that Mr. Taylor, in his "Primitive Culture," vol. i., page 304, describes the legends of Maui as native myths of the setting sun. He arrives at this conclusion partly through having ascertained that the piwakawaka (*Rhipidura flabellifera*)—the little bird that laughed when Maui jumped down his ancestress's throat—is a bird that sings at sunset. It would be an interesting question to ascertain whether that bird is to be found on any of the Polynesian Islands; and, if so, on which?

It has been remarked that the average number of generations from the assumed arrival of the canoes to the present time is twenty, which, if we allow in accordance with Dr. Thomson's reckoning in his "New Zealand Past and Present" twenty-two years for a generation, we are taken back four hundred and forty years since that conjectured disturbance amongst the natives of Polynesia. And again the average number of generations since the separation of Rangi and Papa and the period of the early demigods to the present time is forty-five, which, at the same rate of reckoning, would take us back nine hundred and ninety years. I would ask the question: does not this latter refer to some earlier movement among those races of the Pacific? Or have the long strings of words an allegorical meaning the interpretation of which is long forgotten? The fact of the matter is, the time has not come to generalize, but every exertion should now be used to collect and publish, with as literal a translation as possible so as to convey sense, the traditions, myths, and songs of the Maori and Maoriori, including, of course, those of Polynesia generally.

In what I am about to say I shall merely touch on the accounts of the arrival of Rongokako and Tamatea, and the journeys of the latter, as that subject has been referred to by the Rev. R. Taylor in his "Ika a maui" (on New Zealand and its inhabitants), and by many others. But the history of Kahungunu, the ancestor of the tribe occupying the country stretching from the Mahia Peninsula to Wellington, and the migration of the Maoris now dwelling in our immediate neighbourhood from Poverty Bay and the Wairoa to this part of the country, as far as I am aware, has never before been referred to or published. I would draw attention to the fact that these traditions go to show that Tamatea, who is said to have come in the Takitimu canoe about the same time that the other legendary canoes arrived, found in his journeys people settled at Turanga, Arapawanui, Whanganui, Taupo, and other places; and that his son Kahungunu found people at Turanga; that the Mahia Peninsula was then thickly inhabited by an apparently old-settled population; then again his son and grandson were driven out of Poverty Bay by the

inhabitants, and were again driven from the Mahia, although Kahungunu had become the chief there by his marriage with Rongomaiwahine; and that these wanderers are again repulsed at Wairoa and Arapawanui to find shelter at last with the people of Wakaari and Tongoio, and eventually settled on the plains of Heretaonga, which were at the time thickly inhabited by a people able to construct and garrison a *pa* like Otatara (Redcliffe, near Taradale), with its great entrenchments extending over an estimated area of at least eighty acres.

The Migration of Tamatea and others from Hawaiki, and early Settlement of Hawke's Bay.

This is the legend about the arrival of Tamatea, father of Kahungunu, from whom the Ngatikahungunu take their tribal name. The name of Tamatea's canoe was Takitimu. His companions were his father Rongokako, Hikitapuae, Hikitaketoke, Rongo-i-a-moa, Taihopi, Taihopa, Kahutuanui, Motoro, Angi, Kupe, Ngake, Paikea, Menuku, the children of Tato and others. The reasons for their leaving Hawaiki were two: in the first place, a quarrel about a woman; secondly, a fight amongst themselves concerning Wena. But they had previously ascertained the direction to steer. They went to the forest to search for proper timber for canoes to pass over in. The name of the forest was Tawhitinui. After searching for some time they found suitable trees, six in number, they felled the trees and made the canoos, which was a work for the gods. According to their ancestors, the gods always assisted in great works when the proper incantations and offerings were made to them. Ere long the canoes were completed and ready for sea. The names of the canoes were—the Takitimu, Tainui, Arawa, Matatua, Kurahaupo, and Tokomaru. All being ready, they were hauled down the stream named Hauhau, to the sea. The Takitimu was the first to arrive at the stream, its name was therefore changed to Horo-uta. When all was prepared, they started on their voyage. After being out at sea for some time, the food which they brought from Hawaiki was all consumed, and they were faint with fasting. Then arose Tamatea, and chanted a *mataara*, glaring fiercely with his eyes. The people thought he intended to kill one of the party for food. A man then stood up and called out, "I have got a calabash (*ipu*), full of preserved birds," which were eaten; but ere long hunger again oppressed them. Then, again, Tamatea stood up and repeated as before; and the same fear came over the people that some one would be set apart for food. So another called out, "I have some preserved fish," so they ate that,—and again they hungered. The same man stood up a third time and threatened, and once more food was found: and so it went on until they arrived at Aotearoa (the Maori name for the North Island of New

Zealand). The name of the place where they landed was Whangaparaoa (near East Cape). After stopping there for some time, they worked along to Tauranga, in the Bay of Plenty. Here the canoes separated, some going north, others stopping there, and others again going to different places. But Kupe and Ngake returned on board the Takitimu, leaving Tamatea and his son, Kahungunu, at Tauranga. After Tamatea and his son Kahungunu had resided for some time at Tauranga, on one occasion when they were making fishing-nets, they braided-in the hair of Kahungunu's mother Iwi, which was taken as a great insult. So Tamatea left that place, and settled at the *pa* of Wharepatari, and took his daughter to wife. Her name was Ruatai. After a time Kahungunu followed his father, and resided with him.

The descendants of Tamatea and Ruatai are:—

1 Tamatea (*m*) = Ruatai (*f*)
2 Rauheretieki
3 Ruaroa
4 Kawhareana
5 Kawharatatau
6 Tarakaitata
7 Rangipokuro
8 Kahukuramoia
9 Kota
10 Turia
11 Kahupangare
12 Taraia
13 Whatakai
14 Kahutaarua
15 Rangi Ete Kahutu
16 Waruangaeterangi
17 Hano-o-te-rangi
18 Arawita
19 Ruawewe
20 Tamaiawhituo
21 Heipora
22 Karamana
23 Hapuku Tamaiti.

Tamatea and his son Kuhungunu, after residing for a time at the *pa* of Wharepatari, proceeded to Turanga (Poverty Bay), where they took some lizards as pets, and fed them with *tawa* berries (*Nesodaphne tawa*). The lizards belonged to Tarapaikea. They journeyed on from Turanga. At Arapauanui they observed that the work of that place was catching rats and digging fern-roots. They proceeded on naming places from events that occurred. The next place was Otiere, where *patiki* was the food; then on to Taputeranga, carrying the pet lizards; here they lost one of their pets on the road, so they called the place Poka, which was the name of the lizard. At Waitio they consulted the gods, so that place is called Tarohanga; and they journeyed on until they arrived at Puna-Awatea and Pohukura, on the Ruahine Mountain, near the pass on the present road to Patea. Here they looked back towards Heretaonga (Hawke's Bay) and saw the sea-gulls flying about; hence the saying, "Behold the sea-gulls flying and screeching over Taputerangi (Watchman Island in Napier Harbour), and Oh! the thoughts of the feeds on the thick-sided *patiki* (flounders)

of Tiere (at Roro-o-kuri Island, Napier Harbour), and the delicious fern-root at Pukehou (at Petane), and the fat rats at Ramariki (near Arapauanui), and the glutinous *paua*s at Tahito (near Arapauanui)." This saying was not Tamatea's, but his son's (Kahungunu). [I would draw attention here to the fact that all the places mentioned by Kahungunu in this account appear to have been well known by name, and celebrated for their various products. The same remark applies to places mentioned in other traditions—a certain evidence that people had been there of old, and that the country was well known at the time.]

The father then said, "Are you longing for our home, if so, return?" The son replied, "No, it was only a sigh of remembrance." Here also the lizard scratched in its calabash, so it was taken out and a *heitiki* (a greenstone ornament) was fastened to its neck. It was then placed in a rock cave, and a tree was planted and named Pohukura. The lizard is still there, and its *mana* has not left it. When it roars it is an indication of bad weather. Then they travelled on to the forest to Haupuru, and Turangakira, a rock cave. People journeying generally stop there for shelter. One of the party of Ngaitamahine died there from the frost and snow; thence on to Reporoa and then ascended the mountains at a place called Ranga-a-Tamatea. Here they left a lizard and called the place Aorangi. They afterwards arrived at a settlement near the Wanganui. The chief's name was Tarinuku, who offered the travellers food, including a calabash of preserved birds. Tamatea ate up all the birds, at which Kahungunu was angry, and quarrelled with his father, so they separated, each going by a different road. Kahungunu travelled on by way of Ngapumakaka, Owhaoko Taruarau, Ngaruroro, Ngahuinga, at the head-waters of the Mohaka River, and through to Kaingaroa (Taupo Plains), then returned to Tauranga, and there dwelt.

The father, Tamatea, after his son left him at the *pa* of Tarinuku, journeyed on to Wharekanae, Paraheke, the Hoko, and crossed the Whanganui at Tawhitimu, thence along in the river to Hikurangi and cast anchor at the Punga, then on by Manganui-o-te-ao, Whakapapa, thence across Okahukura Plains to Rotoaira at foot of Tongariro Mountain, then on to Taupo Lake at the Rapa, thence on to Waihi and Pungarehu. There he obtained a canoe and crossed Lake Taupo with his companions to its outlet, where he landed, and through the earth sounding hollow under his feet he called the place Tapuaeharuru (sounding footsteps). Tamatea boasted to the people residing there that he could descend the Waikato River to Okoro in his canoe. The name of his canoe was Uapiko. The people of the place warned him of the dangerous waterfalls, but what was that to this brave chieftain; away he started in his canoe. He passed on

by Nukuhau and Hipapahua and on to the entrance of the race at the Huka falls. Here his friend Ririwai jumped ashore and was saved, but Tamatea and his thirty companions continued on over the falls and there perished. His canoe, in the form of a rock, is still to be seen at that place.

Ko Kahungunu.

We will now return to the doings of Kahungunu, the ancestor from whom the tribe is named, that, on the arrival of the European, owned the large stretch of country reaching from the north of Mahia Peninsula to near Wellington—some two hundred and fifty miles of the east coast of this island.

After remaining for a time at Tauranga (Bay of Plenty), on a certain occasion, Kahungunu, with his sister Whaene and their people, were out fishing; the net belonging to the sister being hauled in, Kahungunu ran and sewed up the fish in the body of the net, at which Whaene was very angry and struck him a blow, of which Kahungunu was so much ashamed that he left the place. When he arrived at the forest he ate some *paretas*, so the place was called by that name. Further on he ate a *kaka*, so the place was called Kaka-Rai-a-mio, then on to Pauauehu and Ngarara, Whakawae, then to Kohahu-Paremoremo; further on he saw a cave, into which he entered. After stopping here for a time he saw a man passing named Paroa, who, seeing Kahungunu, and not knowing who he was, invited him to the village, to which, on the arrival of his companions, he proceeded. After living there for some time Paroa said to his daughter, whose name was Hinepuariari, "Girl, there is a husband for you." Paroa by this time had found out it was Kahungunu, so they became man and wife. Shortly after this one of the women said to Hinepuariari, "How do you like your husband? and she replied, "*Ehara i te hanga, kahore e rupeke ana mai takoto tome mai i waho i te tahu, ka haere te rongo mo te kuha o Kahungunu.*"

When Rapa and her daughter Rongomaiwahine, who lived at Tawapata, near Table Cape, heard the report, Rapa repeated the following proverb:— "*Kei te nui he awa o tatapouri te tuhera atu nei.*"

Kahungunu, on a certain occasion, requested his wife Hinepuariari to comb and dress his hair: so she combed all day until evening; and in the morning she commenced again. She then was able to form it into a topknot, she rubbed it with oil that was held in a *paua* shell (*Haliotis*). After using ten *paua* shells of grease, the hair was not limp, she could not bind it; so she held it fast between her knees, and was then able to get it together so as to bind it with flax; but the flax was not strong enough to hold it,—it kept breaking. So Kahungunu told his wife to fetch his girdle. The flax from which the girdle was made grew at Tauranga. With this

she was able to fasten his hair, the flax being so strong. Hence the proverb, "*Putiki-wharanu a Kahungunu a Tamatea i Mahue atu i Tauranga.*" (The flax-binding of Kahungunu, a Tamatea left behind at Tauranga. *Wharanui* is a variety of *Phormium tenax.*)

Kahungunu then left his wife and journeyed on to Nukutauroa (Table Cape), to Tawapata (near Portland Island) where Rongomaiwahine was living with her mother, Rapa, who had repeated the proverb regarding him. Rongomaiwahine was with her husband, Tamatakutai, the chief of the place, who occupied most of his time in carving. Kahungunu stayed and watched the manners of the people, their food was *paua* (*Haliotis*) and *pupu* (limpets).

At night Kahungunu commenced his jokes, for the purpose of causing a quarrel between Rongomaiwahine and her husband. Shortly after this Kahungunu proposed to the others that they should all go and dig fernroots, to which they agreed. When a great quantity had been obtained, the friends suggested they should tie it up and carry it home, to which he objected and sent them away. So soon as they were out of sight, he collected it all together and carried it himself. When his friends looked back, they beheld him bringing the fernroot on his shoulder. On his arrival at the precipice named Tawapata, just above the village, he let down the fernroot and undid the fastenings, so that it fell scattered into the village. It was such a large mass that the place was filled even to all the enclosures round the houses. All the men, women, and children collected and prepared it for food by the fire, at the same time praising Kahungunu, saying, "Now we have got a strong and able man, who can work and collect food."

The children of Maringaringamai were at the fishing grounds, so Kahungunu proposed to his friends to collect *paua*. He sent the men to collect flax and to make *paua* baskets and nets, and ropes, also to prepare sticks to ward off the fish from the rocks. He then ascended a hill whence he watched the *kawau*—shags—(*Graculus varius*) diving for fish, and then tried if he could hold his breath as long as they could. His way of trying was thus:—When the *kawau* dived, he commenced to count thus: *Pepe tahi, pipi rua*, and so on up to ten (*tuangahuru*); then commenced again at *pepe tahi*, etc. This he did without drawing breath while the *kawau* dived three times; he therefore thought he could remain some length of time under the water, so he took the net at ebb tide and entered the water and swam to the first rock, then to the second, and so on to the fourth, and passed the rocks where people usually swam to, for only a canoe could go so far. He then dived and set to work filling his nets and kits. He pressed the *pauas* together and filled to bursting all his kits. He then

caused the *pauas* to stick to his own body, also his head, and then returned to shore. Those sticking on his head were carried to the sacred place as offerings to the gods: the others were eaten by the people. Then all the men of the village were collected to haul the kits ashore, but they could not; so all the people from the neighbouring *pas* were called, and then they succeeded in hauling the *paua* ashore, and all the multitude feasted on them.

Then the people, seeing the great works of this man and how he could collect food, wondered, and contrasted their own chief Tamatakutai, who could only carve wood, etc., and did not collect food, so they took away Rongomaiwahine from him, and gave her to Kahungunu, and they begat—

Kahukuranui
Tupurupuru
Rangituehu
Hineao
Huhuti, whose husband was the Whatu-i-apiti.

From them are derived the principal families of the whole tribe of Ngatikahungunu.

The Migration from Poverty Bay (Turanga) to Hawke's Bay (Heretaunga).

Turanga was formerly the home of the present Maori owners of the land about Napier, Hawke's Bay, but through the murder of two children, the twins of Kahutapere and Rongomaitara, sister of Rakai-te-hikuroa, they were driven thence. The names of the children were Tarakuita and Tarakitai. How it happened was in this way:—Rakai-te-hikuroa (grandson of Kahungunu, and fourth from Tamatea, who with Rongokaka came from Hawaiki) felt annoyed that the preserved food, such as birds cured in calabashes in their own fat, should be given to the twins in place of being kept for his son Tupurupuru. He therefore determined on destroying his sister's children. The plan he decided on was this:—The children were in the habit of playing whip-top during the day. In Rakai-te-hikuroa's *pa*, named Maunga-puremu, near the present village of Ormond, there was a *kumara* pit by the side of the path. When the children commenced to play, Rakai-te-hikuroa walked up and knocked the tops into the hole, and then told the twins to get them out again. Immediately they were in the hole he filled it up. As evening advanced the parents became anxious and searched in every direction, but could not discover their children. They then made kites of *raupo* leaf (*Typha angustifolia*) shaped like hawks, covering the outside with *aute*,*—paper mulberry (*Broussonetia papyrifera*); these kites were sent up

* The *aute* (*Broussonetia papyrifera*) is said to have been brought by the early Maori settlers, and cultivated to make clothing of the bark: it is now extinct.

into the air. They kept ascending till they were on a level with the *pa* of Rakai-te-hikuroa. They then sailed in a direct line to it, and hovered over his house, and commenced nodding their heads. It was then known who had killed the children. Then Kahutapere, whose *pa* was Pukepoto, near the residence of Mr. W. Chambers, Repongaere, collected his followers and attacked Rakai-te-hikuroa. There was killed Tupurupuru, son of Rakai-te-hikuroa who was defeated, and with his followers fled to Ukurarenga on Mahia Peninsula.

The name of the oven in which Tupurupuru was cooked was *Whakatauai.* The stones used were called *rehu*, and resembled scoria. They were also called *whahukura* and *whaturangahua.* There was also a greenstone *mere* used called *whakatangiara.* After the people had resided at Ukurarenga for some time, Kahuparoro arose to go to Turanga. Rakai-te-hikuroa, on ascertaining his intention, said to him, "Friend, go in peace to where our son rests, but let his spirit hover in quietness over Turanga," meaning that the bones of his son should not be disturbed. On Kahuparoro's arrival at Turanga he collected the bones of Tupurupuru and brought them to the Mahanga, near the Mahia, and there left the skull. He then proceeded on to Nukutauroa (Table Cape), and there made fish-hooks of the shoulder blades. The name of the rock from whence he started to fish is Matakana. When he threw out the hook to fish, he chanted the following *hurihuri* (incantation) :—Divide, divide the waters of Tawake with the red ornamental weapon of Tupurupuru and Rakai-te-hikuroa. Who is thy ancestor? He is Takitamaku Tahito-rangi and Pahito-weka."

When he pulled up the hook he had caught a *hapuku.* Tamaiwiriwiri hearing the chant thought it was Tupurupuru fishing, so he hastened to Ukuraienga and informed Rakai-te-hikuroa what he had heard; Tamaruihiri also discovered that Tupurupuru's bones had been used to dig fernroot with by Hauhau. Then fighting commenced to avenge the insult, and many were killed on both sides. In one of these engagements Hauhau and several others were slain.

Rakai-te-hikuroa and his followers had to retreat to the Wairoa, but the people of that place did not give them welcome, nor supplied them with canoes to cross the river with, so Rakai-te-hikuroa, to make his party appear more formidable, tatooed the women like men, and set up tatooed calabashes, and performed a *haka* led on by Hinekura. The chant used was—"*A tie kei, tie kei tietiekei tiekei tie ha koa, koa koa ei ei.*" The Wairoa people residing near the crossing came to look on, so when they were well scattered Rakai-te-hikuroa and party attacked them and killed many of them, and then proceeded to Arapauanui.

When Tarangakahutai, the chief of the *pa*, saw him and his party coming, he called out "Where is Taraia?" Taraia replied, "Here I am." Tarangakahutai then shouted, "Stand forth that I may know you," which Taraia did. His dress was a mat made of feathers. Tarangakahutai then said, "I shall know you directly, your heart shall be my food."

Taraia then took a stone, and repeating the *tipihoumea* (incantation), threw it at Tarangakahutai, and it knocked his head-dress of feathers off. They fell at Taraia's feet, who called out, "I know that it is I that shall eat your heart presently."

The fighting then commenced, and Rakai-te-hikuroa was driven back. A woman named Hinepare, thinking her people were defeated, took the calabash in which the gods were kept and ascended a rock and broke the calabash, crying out,—"*Cursed be the mothers of these men, presently our nakedness will be exposed to the enemy.*" Her brothers hearing the curse, the crash of the calabash on the rock, and the lamentations of the women, imagined that the head of a man had been broken. So Taraia rallied his people again and returned to the fight, and many were killed.

Here was killed Tarangakahutai and Rakaiweriweri and others of the enemy, and Waikari and others of Rakai-te-hikuroa's party. A dispute arose over the body of Rakaiweriweri as to which family he belonged. Taraia hearing of the dispute, arose and took two pieces of *toi-toi* (*Arundo conspicua*), and cast lots with the *mii*, saying, if of Rakaiweriweri go, if you hold, you belong to this tribe. He cast it, and the *mii* held, he was therefore declared to be of the family of Rakai-te-hikuroa. The incantation used was;—"*Unihia i te pu, unihia i te weri, unihia i takitaki, unihia i tamore i Hawaiki.*" This was the fourth death in payment of Tupurupuru.

Rakai-te-hikuroa and party then moved on to Wakaari, Tauranga, and Heipipi, near Tangoio. The chiefs of those *pas* were Tautu and Tumi. While at Wakaari, there arrived from Heretaonga a man named Totara, who boasted of the abundance and goodness of the food of his place. Tawao said, on hearing of this, the Wanga-nui-o-roto (Napier Harbour, celebrated for its shellfish), shall be the *mara* (garden) of Tawao. Taraia said the Ngaruroro celebrated for *kahawai* shall be the *ipu* (calabash) of Taraia.

The party then moved on to the mouth of the Ngaruroro and drove off Hatupuna and his people, and the Awa-nui-a-rangi and Whatu-ma-moa. Their principal *pa* was Otatara (Redcliffe, near Taradale). Kahukura nui, father of Rakai-te-hikuroa, took to wife Tu-te-ihonga, chieftainness of Whatu-ma-moa, after he had returned from Motuo. Taraia and Porangahou had avenged the death of her former husband who had been killed by the people of that district. So we became amalgamated with that people in the second generation, after the arrival of Takitimu from Hawaiki.

The Migration from Wairoa to Heretaonga.

Wairoa was formerly the home of the Maoris now occupying the inland portion of Hawke's Bay about Te Aute and Poukawa.

The reason for their leaving Wairoa was this:—A chief named Iwi-Katere, living at a *pa* near Turiroa Wairoa, had a pet *tui* (parson-bird, *Prosthemadera novæ-zealandiæ*), which had been taught to repeat the proper prayers and incantations used while planting *kumaras*, *taro*, etc., and thus was very valuable as an economizer of labour. Tamatera, a chief of the adjoining *pa*, borrowed the bird of Iwi-Katere. After having detained it for a length of time, Iwi-Katere sent for his pet, but Tamatera would not give it up, so Iwi-Katere went and fetched it away. When night came on Tamatera went by stealth and took the bird. The *tui* kept repeating to its master the following words:—"I am gone, I am gone, on the handle of a paddle; I am tired of fighting. Oh, Sir, I am gone!" It was waste of words on the bird's part, for its master did not understand the meaning. So Tamatera took it safe away. On the following day Iwi-Katere attacked the thieves, but was repulsed, so he obtained the assistance of Rakaipaka from the Mahia, who had been driven away from Turanga, and attacked and killed Tamatera, Taupara, and many others; but many were destroyed on both sides. After this Ngarengare and the survivors, including his granddaughter Hine-te-moa, moved to Heretaonga and settled in the neighbourhood of Poukawa and Te Aute, driving away the original owners from that district, viz., Tane-nui-a-rangi and others. A great battle took place near Tahoraite, in the Seventy-mile Bush, and from the length of time the people who had been killed took in cooking in the *hangi* or *umu*, the place was called Umutaoroa,—that is the site of the present village of Danevirk. These events happened in the days of Rakaipaka, a contemporary of Kahukuranui and Rakai-te-hikuroa, viz., in the second and third generation after the arrival of the canoe "Takitimu."

The Maori Genealogy from Rangi and Papa to the present time, including Tawhaki and Ruatapu. From the first night to the tenth night.

Kopiapia
Uekiki
Uekaka
Kiwha
Tea
Papa and Rangi

Tanetuturi | Tauepepeke | Tanenatika | Taneuaha | Tane te Wairoa

Ruaupoko | Taweta | Paea | Tane-nui-a-rangi

M. Tane-nui-a-rangi = Hine-a-huone, *F.* / Hine-ti-tamata, *F.*

Rautipua
Rautawhito
Rautaitainui
Punga
Io
Kaitanga
Hema
Tawhaki
Wahieroa
Rata
Rataware
Hutunuku
Huturangi
Hutuauki
Hutupatae
Hoea
Mania
Wakaronga
Tuhorapanga
Tangunoana
Rauru
Uenuku
Iho
Ruatapu
Tamaira
Takaha
Hikawera
Whatiapiti
Wauahanga-o-te-rangi
Rangikawhaia
Manawa-kawa
Matewai
Nga-rangi-ka-tangi-iho
Hineoroia
Tareha te Moananui

The elder from whom the old Priest taught sprang another race than the Maori. His name was Rapuwai. When the Europeans first arrived, they were called by our elders the descendants of Rapuwai.

The younger from whom is descended the Maori race.
Waikura
Putoto
Parawhenua
Horewa
Mokopeke
Pokiki
Pokaka
Paewai
Hine
Hukaawai
Hine Tauwhare Kiokio
Kura Waka
Ahungao-te-ika whenua
Hine rau warangi
Hine hauone, whose *tane* was Raka-maomao

Tongatonga
Atarangi
Ko-te-Ra
Ko-te-Marama
Ngawereponapona
Kurukuru
Pounamu
Kura
Mataoho
Tuna-i-te-rangi
Tonganini
Putehue
Putikonakona
Tuhawiniwini
Tuhakopakopa

Wero-te Ninihi
Wero i iti
Kopa
Tauwhareputaputa
Hikutaipana
Tukokoro
Hinemoa
Karaka
Rangi te Pahia
Warawara te rangi
Whanganui
Rererakau
Hokorae
Harata.

The following is the Genealogy of the late Chiefs Tareha, Ihaka Whanga, and Te Moananui, through the Whatu-Mamoa Tribe—forty-eight Generations:—

1 Pui
2 Awe
3 Tamore
4 Taketake
5 Aka
6 Titamare ki te Waiora ki te Aomarama
7 Ngangahu
8 Ngaenui
9 Ngaeroa
10 Ngaepiha
11 Ngaetahurimai
12 Ngaitahuriatu
13 Akiaki
14 Iaraia ko a-te Manu waere ma
15 Toi
16 Hatoma
17 Iahaukina
18 Rongomaihurangi
19 Rautawaero
20 Rakenui a-te-uhi
21 Rutanga
22 Rakai-te-rangi-ka-noho-i-a Rangihua
23 Ponarangihua
24 Tangikura
25 Kahukura
26 Hineirangia
27 Wawa-te-rangi
28 Maikitekura
29 Maiketea
30 Tuhangateao

1 Tamatea	31 Paetaku
2 Kahungunu	32 Paekaka
3 Kahukuranui *and*	33 Tu te Ihonga.—The chieftainess of the Whatu-ma-moa who lived at Otatara (Redcliffe), whom Kahukuranui, second from Tamatea, who came from Hawaiki took to wife. By her first husband Tupouriao who was killed by the people of Porangahau she begat
4 Rakaipaka *and* Hinemanuwhiri	

5 Kaukohea	34 Remukina
6 Tutikanao	35 Kearoa
7 Tureia	36 Turauha
8 Te Huki	37 Rakai te Kura
9 Rakaro	38 Heneao
10 Wharekuka	39 Hubuti
11 Mitimitioterangi	40 Wawahanga
12 Te Ratau	41 Rangekawhaia
13 Ihaka Whanga	42 Manawakawa
14 Hirieri Te Reto	43 Matewai
15 Te Riria	44 Nga-rangi-ka-tangi-iho

45 Hineoroia te rangi and Herepoio

46 Heiporo	Tareha	46 Tahutahu	46 Pairoa
47 Karamana		47 Karauria	47 Te Moananui
48 Arihi		48 Karauria's children	

A Genealogy including Maui from the commencement, viz., from Rangi and Papa to the present time.

Rarotimu
Rarotake
Potu
Pohaere
Powhakataka
Po-aniwaniwa
Maheatu
Maheawa
Takahuriwhenua
Murirangawhenua
Taranga
Maui.—Sir, this is our ancestor who fished up this island of Aotearoa: he hauled it up with the jawbone of his ancestress. The hook caught the house of Hinenui-te-po. The name of the house was Rarotonga.
Maui begat Wharuakura
Uhenga
Poutaua
Whitirangi mamao
Kupe
Hina
Houmataumata
Paikuiha
Tu-whaitini
Tutaraupoko
Tuaruma
Tukonona
Tuhurutira
Aokarere
Tu-Makaueuru
Tu Makawerangi
Tu-te-Rangikawekite
Tu-te-Rangiwetewetea
Tu-hakirikona
Rakaiherea
Poutawiti
Rakaikoao
Whana
Hora
Tamatetane
Hoakakari
Ropata.

ART LV.—*The Origin of the Boomerang.* By W. D. CAMPBELL, F.G.S.

[*Read before the Auckland Institute, 23rd October, 1882.*]

THE existence of such a peculiar and unique weapon as the boomerang among one of the lowest forms of humanity—as the aborigines of Australia—has excited a great deal of interest among ethnologists; but it has never been satisfactorily explained. It has been claimed as being derived from some hypothetical culture, while on the other hand it is regarded as a specialized form of the throwing cudgel and stick, and that intermediate forms are to be found in Australia, but it has not been understood how the peculiar form and flight of the missile was suggested; and it is upon this point I offer an explanation, which was given me by my friend, W. H.

Blyth, of Russell, who has kindly given me permission to bring it before you. He informed me that he had noticed that the leaves of the *Eucalypti*, when blown off the trees, often acquire the whirling flight and returning action of the boomerang, the leaves tending to return and fall upon the ground perpendicularly below the starting-point of their course.

The correctness of this observation I have repeatedly verified; and this character of the course of the falling leaf, when taken into consideration with the striking similarity in form between the boomerang and the leaves of the blue-gum is, I submit, complete evidence that the origin of the boomerang was due to imitation of the form and flight of the leaves. The absence of the boomerang in other countries is thus accounted for, since the *Eucalypti* are essentially Australian, the bush throughout the greater portion of the continent being chiefly composed of them, while comparatively few are to be found elsewhere.

That the Australians had a throwing missile previous to the development of the boomerang form, is rendered probable when one considers that a strong resemblance in typical character appears to exist between the Australian and the Indian Dekhan tribes, and possibly the ancient Egyptians. Colonel Lane Fox has grouped them together in his classification of weapons; and Prof. Huxley had previously taken these races to comprise the lowest forms of his *Zeitrichi*, or smooth-haired people, since they all possess long prognathous skulls, with well-developed brow ridges, dark eyes and black hair. The Dekhan, or aboriginal tribes of India, had a missile which they whirled in the manner of boomerangs to bring down game. The rudest kind is described by Sir Walter Elliot as being found in the South Mahratta district, and were merely crooked sticks, the most developed form being the "Katuria" of the Kules of Gujerat, a weapon resembling the boomerang in shape, and in being an edged flat missile preserving its plane of rotation, but being too thick to swerve or return.

The Egyptian fowler used a throwing cudgel. (See E. B. Tylor's "Early History of Mankind.")

These forms of weapons in races allied to the Australians would seem to

indicate that the boomerang had been developed from them to its present form by the Australians often witnessing the peculiar course of the *Eucalypti* leaves, all savage races being keenly alive to the improvement of their weapons. In the diagram is shown the form of the boomerang compared with some leaves of the *Eucalyptus globulus*. The curved sectional form, essential to the soaring flight of both boomerang and leaf, is present in each.

Art. LVI.—*On the Importance of Forestry.*

By D. McArthur, Inspector of Forests.

[*Read before the Southland Institute, 20th September,* 1881.]

I have been since my boyhood a lover of trees in all stages of growth as forests and as single trees. When attending school in the year that Waterloo was fought, I had to pass through two miles of a beautiful plantation, at the end of which was a large barn, where the then Earl of Breadalbane had a number of men threshing larch and fir cones with flails, and on my enquiring why they were threshing the *sticks*, I was shown a handful of the seed and informed that these would grow into large trees. Fortunately the head gardener's son was my class-fellow, consequently I had the privilege of following the seed to the nursery, and in due time the seedlings to the hillsides and barren moors, where I had the further privilege of being permitted to plant some; and now there are thousands of acres of magnificent forests clothing the previously barren land with beauty and wealth. Land then not worth a shilling an acre is now worth from two to three hundred pounds.

The Scotch fir is planted amongst the larch, oak, elm, etc., on account of the shelter afforded to the latter owing to its bushy form, and it is frequently planted in belts of a chain or two wide on the weather side of young plantations, for the same reason.

The Earl of Wemyss and March about fifty years ago planted extensively in the upper parts of Peebleshire and around Nidpath Castle, and along the Tweed, beautifying the country and greatly increasing the value of his property.

There is a stretch of country about half way between Edinburgh and Peebles known as the "King's Edge," and when I first saw it I could not imagine anything more desolate and cold-looking. It consisted chiefly of a large extent of cold, wet, inert peat-bog, lying on a bed of impervious concrete. So hopelessly barren was the surface that it would not even grow a *windlestraw*. The proprietor cut it into strips and squares by open ditching, breaking the concrete bottom, and planted belts of Scotch fir and other trees as breakwinds across the prevailing winds. When I saw the locality again in 1850, the plantations were thriving beautifully, and now it is converted into fine fertile fields.

The climate was completely changed by the draining and planting. I have seen the management of a very extensive natural forest in Argyleshire, consisting chiefly of oak, ash and birch, skirting the base of Ben Cruachan and bordering the shores of Loch Awe. This forest consists of many thousands of acres, reproducing itself by stooling, as it is technically

termed, in other words a young crop growing out of the stumps of the trees recently cut down. This territory was leased for ninety-nine years by a company of Liverpool gentlemen and dealt with as follows :—

It was subdivided into about twenty sections and one was cut down every year in spring and summer, when the sap was up, and barked chiefly by women and children ; the bark being taken to Liverpool and the timber converted into charcoal for smelting iron ore—which was brought from Ulverston to Bunawe by the company's schooners—there converted into charcoal bar-iron and taken back to Liverpool as ballast, the vessels being filled up with the bark and wool of the district.

The iron produced at this small furnace brought the highest price in the British market, being sold for from £10 to £15 per ton, and was utilized for what is known as cold-drawn wire.

Each subdivision when cut was protected by rough fencing to prevent cattle from eating the young shoots and the finest oak tree in the division was left as a standard at each periodical cutting. The result of this forestry management was that three or four successive generations made fortunes, and the forests, when I left Scotland in 1860, were at least as flourishing as at the beginning of the lease. The lessees never planted a tree, but merely conserved and utilized what they found on the ground.

The forests here are not deciduous, and, when cut down, the stumps gradually die out; at the same time they reproduce themselves from the fallen berries, but are very slow of growth.

I counted 500 rings on the planed stump of a black-pine tree in Seaward Bush, the diameter of which was only about three feet, whereas a healthy larch would exceed that in about a tenth of the time, and the timber be of more value for every purpose, from the construction of a wheel-barrow to that of a ship.

Larch is also very durable in or out of the water. Piles of only thirty years' growth were used in extending one of the Oban jetties in Argyleshire, and after being twenty-five years in use were as sound as when driven, and not touched by a *Teredo*.

Larch and fir are used for coal-pit props and railway-sleepers throughout Great Britain.

In the course of a few years all the railway-sleepers in New Zealand will have to be replaced, which will pretty well exhaust the available timber suitable for the purpose, hence the desirability of planting trees of quicker growth than the native ones. It is said that larch and fir will not thrive here, as they happened to fail with some run-holders in Otago. It would be surprising if they did thrive, under the circumstances; having been taken from a cosy nursery and planted into holes of solid clay, where

the poor plants were being alternately drowned in wet weather, and in dry scorched for want of moisture. Such soils should be cut by a sub-soil plough to the depth of 18 inches or 2 feet, drawing the furrow slightly down hill, letting the surplus water away, while the pulverized and stirred clay would retain sufficient moisture. It would be an additional advantage to turn over a furrow of the top vegetable mould with the common plough, the sub-soil one following in the same furrow; by this means the young plants would have the benefit of the old surface soil to start them.

In an earthy kindly soil all that is necessary is to make a slit with the planting spade—pushing the slit a little open—when your boy, with his basket of seedlings, drops one in the slit, and puts his foot on the sod closing it.

Planting here should follow the sawmillers and this cannot be done too soon. The remark is frequently made "cut down the forests, there will be plenty of timber to last *our* time. Convert the forest lands into agricultural holdings and cover the country with men, women and children."

Those who make such remarks are evidently not aware of the fact that in many parts of Europe and elsewhere the cutting down of the forests resulted in converting countries formerly fertile and well peopled into absolute deserts, necessitating the removal of man and beast to look for food elsewhere. This ought to be a warning to the people of this grand country to conserve their native forests ere it be too late.

Man is cradled in timber, housed in timber, and coffined in timber, he therefore ought to take care of his cradle, his cottage, and coffin, while he can.

I intended to have produced historical proofs of the evil effects of the denudation of forest lands, I will however do so, if well, on a future occasion.

ART. LVII.—*The Surface Features of the Earth and Local Variations in the Force of Gravity.* By T. B. WAKELIN, B.A.

[*Read before the Wellington Philosophical Society, 12th September*, 1882.]

IN a former paper the nature of the physical agent causing gravitation was carefully considered. This paper seeks to confirm the views expressed in that paper, and it will be necessary to recall three points on which much weight was placed. They are—

(1) That gravitation *is* produced by a *physical* agent, the ether, which according to a growing belief is what is commonly understood by the "electric fluid."

(2) That this ether is composed of *corpuscules* which have a very high velocity of *rotation*.

(3) That owing to the form and action of the ethereal corpuscule it will adjust itself to the surface with which it is in contact. More strictly, since the ether penetrates all bodies, the corpuscules will adjust themselves according to the nature as well as to the form of the surface.

If the ether is composed of rotating corpuscules then, by contact with the earth, their velocity of rotation will be gradually reduced, and according to the theory explained in the former paper these corpuscules will combine with the solid matter which they have penetrated. In this way the earth would grow larger by the addition of matter which has been reduced to an ordinary state, that is to matter as we commonly understand it. The matter of the ether may be described as matter in an "extraordinary state." Astronomers maintain that the earth is growing larger, however gradually, and but very recently the view was put forward that this gradual increase in the size of the earth was due to showers of meteoric stones. The total quantity of meteoric matter, however, falling on the earth, was found by calculation much too small to produce the increase in the size of the earth. Professor Seeley, in a course of lectures on geology, delivered three or four months ago at the Royal Institution, expressed his conviction that the earth was being increased in size by some gradual process of addition.

The corpuscules of the ether are so constituted and act in such a manner as to adjust themselves to a flat surface, so that their outsides will revolve in the direction of that surface. More strictly it should be said that the ethereal corpuscules adjust themselves to what may be called a predominating surface. By a predominating surface would be understood a surface that has the greatest influence on the direction of rotation of the corpuscules. The solid and immovable land would have a greater influence than the mobile ocean, and dense solid matter than relatively lighter matter. The plumb-line has been found to be deflected from the true or astronomical vertical, in two ways, both probably owing to the same cause. The first is well known. Mountains deflect the plumb-line from the true vertical. In mountainous countries, as near the Alps and Caucasus, this deflection amounts to as much as 29″ of arc. The other case is this, the plumb-line hangs perpendicular to the surface of still water always, but the direction of the plumb-line is very frequently not in the direction of the centre of the earth. As bearing on this point, though not clearly understood, the following extraordinary facts should be quoted:—

"At sixteen astronomical stations in the English survey the disturbance of latitude due to the *form of the ground* has been computed, and the following will give an idea of the results:—At six stations the deflection is under 2″, at six others it is between 2″ and 4″, and at four others it exceeds 4″.

There is one very exceptional station on the north coast of Banffshire, near the village of Portsoy, at which the deflection amounts to 10″, so that if that village were placed on a map in a position to correspond with its astronomical latitude, it would be 1,000 feet out of position! There is the sea to the north, and an undulating country to the south, which, however, to a spectator at the station does not suggest any great disturbance of gravity. A somewhat rough estimate of the local attraction from external causes gives a maximum limit of 5″, therefore we have 5″ unaccounted for, or rather which must arise from unequal density in the underlying strata in the surrounding country. In order to throw light on this remarkable phenomenon, the latitudes of a number of stations between Nairn on the west, Fraserburgh on the east, and the Grampians on the south were observed, and the local deflections determined. It is found that the deflections diminish in all directions, not *very* regularly certainly, and most slowly in a south-west direction, finally disappearing, and leaving the maximum at the original station at Portsoy." *

Professor Maxwell believes the ether to be made up of *rotating* corpuscules *fixed* in space. That the ether is composed of rotating corpuscules is also the expressed opinion of Mr. Preston, who has made a special study of the ether. Sir William Thompson has shown that magnetic attraction is a rotational effect. Sir John Herschel expresses the opinion that the ether is composed of *corpuscules*, and says in a very decided manner that *they must be fixed in space*, and that they *may* rotate. The writer of this paper had expressed views in strict accordance with these just given. He has endeavoured and still endeavours to show that gravitation is a rotational effect, and, if so, that the ether, or "electric fluid," is the physical agent producing gravitation. Now, as the ether penetrates all bodies and comes in contact with them the velocity of rotation of the corpuscules becomes gradually much reduced by this contact. Eventually these corpuscules combine with the bodies they penetrate, probably making them more dense and also adding to their mass and bulk. Solid rock would have a greater effect in reducing the velocity of rotation of the ethereal corpuscules than earthy or gravelly beds. Consequently all the striking solid features of the earth would become rather exaggerated than reduced by the direct action of the ether alone. "The Uniformitarian Theory" in geology declares that the basis upon which it stands is "that the continents have always been continents and the oceans oceans." The great features of the earth "persist." Whatever great features now exist—as the Himalayas and the Alps, the deep basins of the Atlantic and the Pacific—have always existed in their characteristic features.

* See Article "Earth" (figure of) in the Encyclopædia Britannica, by R. E. Cook

The rotation of the ethereal corpuscules within the surface of the earth would be so considerably reduced that the force of gravity would be lessened. The corpuscules, whose rotation had been reduced, would react on those at and probably immediately above the surface of the earth. According therefore to the nature of the layer of the earth's crust, whether of greater or less density, so would vary the force of gravity very near the earth's surface. Where these layers were *very dense* there the force of gravity *would be less.* In a very hard rocky country the force of gravity would therefore be less than at the surface of the ocean. If a mountain is more dense than the surrounding country the force of gravity on the top of the mountain should be less than on the surronnding plains. Until the nature of an accelerating force is understood, the principles here sketched cannot be extended with any satisfaction beyond the surface of the earth.

The following bears directly upon what has just been said :—

"An immense number of pendulum observations are now being made at the astronomical stations of geodesical surveys in Germany, Russia, and India, which, when fully published, will throw light more perhaps on the local variations of gravity than on the figure of earth. The observations made at the various stations of the Indian meridian arc bringing to light a physical fact of the very highest importance and interest, namely, that the density of the strata of the earth's crust under and in the vicinity of the Himalayan Mountains is less than that under the plains to the south, the deficiency increasing as the stations of observation approach the Himalayas, and being a maximum when they are situated on the range itself. This accounts for the non-appearance of the large deflections which the Himalayas, according to Archdeacon Pratt's calculations, ought to produce. The Indian pendulum observations also throw some light on the relative variations of gravity at continental, coast, and island stations, showing that, *without a single exception*, gravity at the coast stations is greater than at the corresponding continental stations, and greater at island stations than at coast stations." The inference, that because the force of gravity in any locality is less, the density of the earth at that place is less, is one usually made, but it is more credible that mountains are denser than the plains which are made up of detritus from those mountains than that the plains are denser than the mountains."*

Prof. Darwin made experiments during last year, in which he discovered variations in the force of gravity. He has embodied the results of his investigation in a paper which was published in the November number of "Nature" last year. His investigations showed that the force of gravity *varied* at the very same place, that there was on one or two days a *diurnal variation* in the force of gravity.

* See Article "Earth" (figure of) in the Encyclopædia Britannica, by R. E. Clark.

It may be deemed quite practicable to devise experiments to test the question whether gravitation is due to the rotation of stationary corpuscules or not. With adequate and effective means the following experiment might be considered sufficient for this purpose. Let a very short solid cylinder, of any hard or dense substance, have fixed in it an axis on which it can be revolved by a driving-belt. Such a short cylinder would be very much like a thick grinding-stone. It should be from 1 to 2 feet in diameter, and from 6 to 12 inches in thickness. The denser the material the better, but tough hard heavy wood would probably do, as the conditions could be varied to suit the density of the substance. This wheel should be made to revolve with a velocity of not less than twenty revolutions per second; and means should be provided for increasing the velocity up to 1,000 revolutions. The weight of the wheel and axle would be determined first when at rest. *While revolving* at any chosen velocity, let it *again be weighed.* It should weigh *less*, and if the substance is dense and the velocity great, it should weigh considerably less. It would be reasonable to suppose that the fixed rotating corpuscules of the ether would be very much disturbed,—would not have time to adjust themselves to the revolving wheel, and would therefore have a less gravitational effect. Such an experiment as this, however, if effectively made with the best appliances, would probably be somewhat costly,—at least for any one individual.

ART. LVIII.—*Hawaii-nei and the Hawaiians.* By F. B. HUTCHINSON, L.R.C.P.

[*Read before the Wellington Philosophical Society, 26th August*, 1882.]

ABSTRACT.

THE Sandwich Islands are famed for their beauty and fertility. Five thousand miles distant from the New Zealand group, they are peopled by almost the same race, a race speaking a language not differing more widely from the Maori than the dialects of the latter do from one another.

The Sandwich group consists of five larger and several smaller islands, lying in a line from north-west to south-east. Beginning from the north-west Kauai is the oldest, has no signs of recent volcanic action. Earthquakes are the rarest, the rocks are the most broken down into soil. Hence it is the most fertile; it is spoken of as the Garden Island. As a whole, the island radiates from one grand very precipitous mountain 6,000 feet high. In this island the language, though differing so slightly from that of the other islands as hardly to form a dialect, approaches a little more nearly the Maori. R is often used for L, and T for K. Thus one hears there of Hanalei pronounced Hanarei, and Kauai as Tauai. The forests on Kauai are magnificent, and the plantations mostly prosperous.

Oahu is made up of two long mountain ridges, with a plateau between. It bears Honolulu, the capital, and this on account of possessing the only really good harbour in the group.

Molokai is a long mountain running east and west, with the northern half removed. Thus it presents to the sea on the north a stupendous precipice. From this about the middle projects a piece of low flat rich land, used as the famous leper settlement.

Maui is composed of two mountains, the higher of which (10,000 feet) is a vast extinct volcano, the crater 27 miles round broken by two great gaps. The crater is the most remarkable upon earth as resembling a smaller lunar volcano, having several craters rising from its 2,000-feet deep cavity. It is known as Haleakala, or the House of the Sun.

Hawaii is the great island, that from which the group takes its name. The great volcano Mauna Loa (13,600 feet) stands in the centre. To the north is a beautiful mountain still higher—Mauna Kea, and there are smaller ones. Mauna Loa is the most interesting of all volcanoes. It does not show its height, the base being 60 miles across, and there are no peaks. I exhibit a diagram showing its general shape. The effect when on the mountain is that of being on a plateau. There are two extinct main craters besides those that occasionally burst out. The summit crater, 13,600 feet above the sea, is always active; the better-known Kilauea, 4,000 feet above the sea, on the east side, is, too, always active. It is clear from the difference of level that the two can have no connection. These craters do not shoot up stones and ashes; they are lakes of molten lava, and constantly change their levels, occasionally overflowing.

There are on the islands about 60 sugar mills, several with more than one plantation attached.

The Hawaiians are often spoken of as Malayo-Polynesians, but this is almost certainly a mistake. The whole subject of the origin of the race is discussed with great ability by Judge Fornander in his work on the Polynesian races.

Political.—Formerly each place had its own chief. Warfare was the normal state. The chiefs were a splendid race, well marked off from the common people. Descent was wisely reckoned in the female line. The finest women became *tabu* to the chiefs, and thus the superiority was produced. The old Greek race probably produced no specimens of humanity physically finer, and in intellect they ranked very high.

Late in the last century a chief of Western Hawaii, Kamehameha, conquered first his own and then the other islands. He died in 1819. His successor insulted the national deities and broke the *tabu*. Very soon afterwards the first batch of missionaries reached the islands.

Their success was, from their own point of view, wonderful and unprecedented. In a few years churches and schools marked every village, the natives were nominally christians, the old superstitions hidden out of sight and supposed to be extinguished and the language was reduced to writing. Then a Catholic Mission appeared and was forced upon the king and people by a French man-of-war. A painful conflict between the two faiths took place. This gradually subsided ; a large portion of the natives adopted the newer faith, its spectacular ritual appearing to suit them far better than the other, while the singularly self-devoted and humble lives of the priests have largely aided in the same direction. Now the two live peacefully side by side. There is no religious census of the islands ; but, to hazard a rough guess, perhaps a third of the natives are Catholics, and the proportion increases.

The Protestant missionaries quickly acquired important political powers. They stood out as the protectors of the natives against the vice and selfishness of the white traders. One, Dr. Judd, a man of great ability, was for many years the head of the government. The native kings, able men themselves, gladly availed themselves of the superior knowledge of the foreigners. Had these white men been English, no doubt the islands would have become an English colony. As it was, they were seized and annexed by Lord George Paulet, commanding an English man-of-war, an act quickly disavowed by the English Government. Colonies are outside of the American political system, and the great aim of the white ministers was not to annex the islands to America, but to build them up into an independent sovereignty under the native king. It is a fair question whether it would not have been better for the natives had the islands become a British Crown Colony ; the decay of the race, it has been thought, might have been less rapid. But looking to the history of the Maoris and Fijians, the soundness of such an opinion may be greatly doubted. The lecturer had not been able to discover that the two last races are better off than the first ; as to the value of the work—religious, political and social—of the missionaries in the islands there are such wide diversities of opinion that the lecturer declined to enter upon a ground of such hot controversy. Being human the missionaries could not, with all their good intentions, avoid errors, and many of them would now confess that their errors were many and serious. They were misled by thinking that they had a force at their back strong enough to change human nature and turn a half-savage native into the highest class of New Englander.

The land tenure and political system was at first feudal, but in 1839 Kamehameha III. abolished the feudal tenures and gave the country a constitution. This was abrogated by Kamehameha V. and a new one

given, which is now in force. The king is a constitutional monarch, but not according to English ideas. The form is more that of the late French Empire. The government is personal, the ministers being appointed and removed by the king at his own pleasure and without any reference to the legislature, towards which they have no responsibility. The present king has appointed and removed ministers in a most arbitrary manner. For instance, in 1878, being displeased, he sent at 1 a.m. to demand their immediate resignation.

The Ministers are four,—the Foreign Minister, who is usually the Premier; the Minister of the Interior, who is the real working Minister, for whom nothing is too great or too small; the Finance Minister; and the Attorney-General. The Foreign and Finance Ministers have frequently been figure-head natives. Two years ago the Finance Minister for a short time was a native preacher, perfectly ignorant of his subject, and appointed only because no respectable man could be got to take the office.

The Legislature, which, happily for the country, meets only biennially, consists of two estates; but they sit and vote as one House. The Nobles, twenty in number, are appointed by the King for life. They have no special title except Honourable. Many of them are "foreigners." The twenty-eight representatives are nearly all natives, and thus in the House as a whole, the natives are in the great majority. They possess and represent very little property, but vote away most recklessly the money of the foreign population, who pay all but a trifle of the taxes. In the session of this year they voted three and a half millions of dollars, including a Civil List of $148,000, to be spent in the next biennial period, the estimated income for that time being $1,950,000.

The proceedings of the Legislature are conducted with great dignity and propriety; but everything being done in two languages makes it extremely tedious, the more so that the natives are born orators, and can discourse for the hour together, even though they have nothing to say.

With all the weakness of the legislature, mostly, be it remembered, composed of natives, the laws of the Sandwich Islands, and the judicial procedure generally, compare favourably with those of any other nation in the world. They are the cream of American and English jurisprudence, and have generally been administered by Judges of high character and ability. As an instance where the procedure is vastly in advance of that of England,—the accused is, at his option, put into the witness-box and examined under oath.

The sanitary affairs of the islands are supervised by the Board of Health, whose duties are more serious and responsible than usually fall to the lot of similar bureaux elsewhere, for they have in their hands a terrible charge

from which most other countries are free—the leprosy: also the isolation of all cases of infectious disease that may be brought to the islands, a business which necessarily incurs much odium. In all such cases the people in immediate contact with the patients are immediately and carefully separated from the rest of the community, a course which might elsewhere be followed with advantage. It is a disgrace to any country not continental that such a disease as scarlet fever should ever gain, or at least keep, a footing in it.

An account of the leprosy and of a late epidemic of smallpox was then given, and the subject was treated more at large in a subsequent lecture, delivered before a special meeting of medical men.

The causes of the decline of the native race.—No doubt Captain Cook's estimate (400,000) was far too high. He reckoned from the numbers that appeared at each place where the ship touched, not considering that they crowded thither from all parts of the island. In 1832 the number was 130,000, in 1878 47,000.

Syphilis was introduced by Captain Cook's sailors, and has inflicted terrible injury on the race.

The leprosy has aided in the same direction.

The removal of the tabu from the women.—With all the drawbacks of the *tabu*, it was certainly a great protection to the women. Its abolition gave full swing to license. The women are markedly unfertile, but are far more fruitful with white men and Chinese than with their own race.

The early age at which intercourse begins with both sexes is another cause of infertility.

The women manage their babies unwisely, and the infant mortality is very large.

The changed conditions of life.—The dark races appear to be always injuriously affected by close contact with the white. The wearing of clothes, and living in tight houses, has proved a great curse to the natives, who are far more delicate and prone to lung diseases than when they went naked and lived in grass houses.

A very large number of the women live with white men and Chinese. This cause alone must in the end prove fatal to the purity of the race.

Present state and prospects.—The islands are now part of the American system. The policy was laid down by the late United States Foreign Secretary, Mr. Blain. Extract from letter of his to the United States Minister at Honolulu, dated December 1, 1881:—"In thirty years the United States have acquired legitimate and dominant influence in the North Pacific, which it can never consent to see decreased by intrusion therein of any element or influence hostile to its own. * * * * Hence the

necessity * * * * of drawing ties of intimate relationship between the United States and the Hawaiian Islands, so as to make them practically part of the American system, without derogation of their absolute independence."

Thus America does not desire to acquire the islands, but to hold supreme control there, and this is practically effected, most of the white office-holders and property-holders being Americans. As they now are the islands might well go on preserving their independence for an indefinite time, but already that independence has been gravely endangered, and will probably not last long. An American protectorate will probably take the place of the monarchy, with provisions for self-government. The person by whom the independence has been and is endangered is the king. Further, the former cordial relations between the native and foreigner have been seriously impaired.

The native cannot be educated beyond a certain point. As a boy he is very bright and clever ; as a man he amounts to very little. Not a single business of any kind in Honolulu, except that of selling meat, is either conducted by a native or has a native in a high position in it. The native royalty must soon end. The pure native race must soon die out. The Hawaiian cannot adopt our civilization. He will not work ; so, while the American and Chinese come in in swarms to do the work, he is quietly fading away. A sad end to a beautiful, gentle, kindly race.

Art. LIX.—*The Effects of School Life on Sight.* By B. Schwarzbach, M.D.

[*Read before the Auckland Institute, 31st July,* 1882.]

It is nearly four years ago I had occasion to examine the sight of the children attending schools in Auckland. In the report of my examination, which was kindly received by the members of the school-board, I stated the percentage of short-sightedness which existed amongst the school-children, and I also pointed out the dangers of school-life in regard to the sight, and how such dangers might be removed or lessened.

During the last three years, while sojourning in Europe, especially in England and Germany, I have still pursued my favourite branch of study, and I have endeavoured to acquaint myself with the progress made and attention given to arrest the pernicious effects of bad light, bad printing, bad ventilation, and bad seats and desks in our schools at home. I have carefully compared the statistics of short sight, taken twelve years ago, with the statistics taken recently and I have noticed that apparently the evil has at least not advanced in its stride. This is no doubt especially due to the

efforts of some of our scientific men, who have repeatedly drawn the attention of the public and of the officials towards the causes which endanger a whole nation to advance from the stage of short sight to that of weak sight. Hirschberg in Berlin, Cohn in Breslau, Sibreich in London, and others, have lectured and written on the subject; and it is my intention in this short paper to give a hurried synopsis of their opinions and of my own observations in this matter.

The changes in the functions of the visual organ, which are immediately developed under the influence of school-life, are the following:—

1. Decrease of the range of vision.
2. Decrease of the acuteness of vision.
3. Decrease of the endurance of vision.

1. Decrease of the range of vision,—short sight,—(*Myopia*) is that condition of the eye in which rays of light are united in front of the retina in consequence of an extension of the axis of the eye.

As a rule, shortsightedness appears only feebly developed in children, and with proper attention could be stayed, often removed. The most dangerous time for such eyes are the years between eight and fifteen. The visual organ is then in a state of change and growth, and very susceptible to outer influences, the effects of which become easily settled and permanent. When the children look persistently at near and small objects, an undue pressure on the eye is produced by the accommodation muscle, as well as by the accumulation of blood, caused by the stooping position, thus gradually expanding the visual axis. The young scholar not only remains shortsighted, but the defects increase in proportion to the admittance of injurious influences. The sedentary occupations of learned men, or watchmakers, engravers, and others furnish us with a striking example how easily the power of sight for distant objects may be impaired. Shortsighted eyes should not only be guarded against over-straining, especially against evening work, but proper counter-influences against the prime causes should be instituted. In the same degree as excessive working on near objects may gradually produce an expansion of the eyeball from the front to the back, in the same degree could this be prevented by practising the sight upon distant objects, by much outdoor exercise (also school-gymnastics) and carefully guarding against that which is obnoxious to a normal development of the organ. And in sinning against this normally natural development, the schools in particular may be accused. Excessive reading predominates over oral teaching in too great a measure. I do not mean so much in the rural schools or lower public schools, but in the universities and colleges, where a vast amount of mental work must be accomplished in order to enter with honorary degrees into professional life. If extensive

learning is identical with advanced culture, then, indeed, knowledge is a dangerous present of civilization as regards the sight. And if knowledge is transmitted to our brains by means of our eyesight in badly-lighted and badly-ventilated rooms through small and indistinct print, and by sacrificing proper rest and sleep, then shortsightedness will make its appearance in a more aggravated form, and more quickly, than under proper hygienic conditions.

In order to stem the tide of short sight, Prof. Cohn, in Breslau, makes the following demands to the schools throughout the civilized world—demands to which I fully consent :—

For the protection of eye and sight of school-children it is necessary—

1. To have a pause of fifteen minutes after every lesson of three-quarters of an hour.

2. To pause half an hour at eleven o'clock, if the morning instructions are carried on during five hours.

3. To have a reading board for testing the sight fixed in the room. If certain letters cannot be distinguished at a certain distance, the pupil must rest the organ.

4. To shorten the lessons and the tasks at home.

5. To introduce lessons on hygiene in all schools, colleges, and universities.

6. Every Council of Education should have a medical man as a member.

7. To close, by law, all school-rooms which are badly lighted and insufficiently ventilated.

In Germany, the nursery of short-sightedness, the above injunctions are of vital importance. But also England should adopt them, as the evil of short sight has increased rapidly in that country during the last twenty years. Australia and New Zealand are in a too sympathizing contact with the motherland to be entirely excluded from the unpleasant influences of the latter.

It is true that short-sightedness is often hereditary, but this must not be thought to mean that the children of short-sighted parents are born short-sighted. They have only the predisposition to become so, and their predisposition is developed during school-life, more or less, according to certain external conditions; and the more so, of course, under conditions which tend to produce short sight even in children who have no hereditary predisposition.

Prof. Sibreich points out and demonstrates that short-sightedness has also an injurious influence on the general health by inducing a habit of stooping. Its increase from a national point of view is to be considered a serious evil. In former times, when literary education was confined to a

small number, this question was of little or no importance, but now, especially when England and its colonies are about to extend the benefit of school-education to all children, the question how to prevent short sight deserves serious consideration.

I mentioned in the beginning, that not only Myopia, but also a decrease of acuteness of vision, so-called Amblyopia, is frequently developed during school-life. Often this serious condition is the result of a positive disease in the interior of the eye, which is of too individual a character to be considered here. However, amblyopia of one eye, is mostly produced by unsuitable arrangements for work, which disturbs the common action of the two eyes, and weakens the eye which is excluded from use.

But even more frequently than this defect is a decrease of endurance of the vision—Asthenopia. This very frequent affection, which has destroyed many a career, prevented the development of many a fine intellect, and deprived many of the fruits of their laborious exertions and persevering industry, arises principally from two causes. The first is a congenital condition, called hypermetropia, which can be corrected by convex glasses, and which cannot therefore be laid at the door of school-life. The second is a disturbance of the harmonious action of the muscles of the eye—a defect which is generally caused by unsuitable arrangements for work.

It is not my intention to enter here on a scientific explanation of the various causes of these disturbances of the organ of sight, for the three anomalies I have mentioned all arise from the same circumstances—viz., insufficient or ill-arranged light, or from a wrong position during work.

Insufficient or ill-arranged light obliges us to lessen the distance between the eye and the book while reading or writing. When the eye looks at a very near object, the accommodating apparatus and the muscles which turn the eyes, so that the axes converge towards the same object, are brought into a condition of greater tension, and this is to be considered as the principal cause of shortsightedness and its increase.

How can these evils be prevented? In answering this important question, I do not pretend to express an original opinion only. As a disciple of those great men who have made ophthalmology a flowery limb on the great tree of medical science, I must confine myself to repeat their teaching, and I do so in the firm belief of teaching the truth. But common sense even could answer the question before us.

The light must be sufficiently strong and fall on the table from the left-hand side, and, as far as possible from above. The children ought to sit straight, and not have the book nearer to the eye than ten inches at the least. Light coming from the right-hand is not so good as from the left,

because the shadow of the hand falls on that part of the paper at which we are looking. Light from behind is still worse, because the head and upper part of the body throw a shadow on the book; but the light that comes from the front and falls on the face is by far the worst of all, for, in the first place, it does not attain the object desired, and, next, it is most hurtful to the eyes. It is hurtful because, firstly, the retina becomes fatigued by the full glare upon it, and the diffused light renders the comparatively dark images of the printing and writing more difficult to be perceived. Secondly, the position assumed by the children, in order to avoid the disturbing influences of the light, places the axis of the eye in a very unfavourable direction, which, as I have already mentioned, induces short sight, differences in the sight of the two eyes, and certain weakness of the muscle of the eye.

If, in consequence of such bad light, the child is necessitated to hold the book high up to the face to distinguish the letters clearly, then the consequence will be as before mentioned. The human eyes are moved in different directions by six muscles. The muscles of both eyes can only be brought into contemporaneous action in a certain way. Thus we can only move both eyes at the same time up or down, or bring them together from parallelism to convergence, and *vice versa*. Of the possible combination of the muscles, some can be brought into action for a length of time, others only for a few seconds. Thus we can only with an effort look at a near object if it is higher than the eye. On the contrary, we can look with ease at an object equally distant if it is below the eye. Therefore you must not think that the natural position of the book while reading depends upon chance. It is a physiological necessity; if we strive against it the eye becomes fatigued, and, if the effort is repeated regularly and for a long time, a derangement of the harmonious action of the muscles of the eye is the consequence.

I have dwelt on these matters exhaustively in a lecture on the human eye which I delivered four years ago in Auckland. I also laid a special stress not only on the pernicious effects of bad light, but also of bad print. Books badly printed or with very small type are certainly not fit for continued use, for in many cases an eye-disease is imprinted therein. In order to prove to you what importance is attached to clearly-printed books at Home, let me state that some years ago the Ministerial Board of Education in Germany condemned over half a million of books by reason of their indistinct type.

With regard to the various positions of the desks and seats, let me quote again Professor Sibreich, who says it is difficult to give an account of the reason for the positions those desks and seats occupy; in fact, they appear

to be the result of mere accident. Sometimes unimportant circumstances —such as the position of the door or fireplace, or the best place for the blackboard—have decided the matter. More frequently it has depended on the desire to have the faces of the children in full light. Against this I have already declared myself. Most frequently, however, the wish to place the children as near as possible to the master has regulated the arrangement, and has led to placing the seats in a horseshoe form; but also in this arrangement only one-third of the children can have a proper light. I admit it is very difficult to answer all requirements in this respect, especially if the schools have not been built with a proper consideration to the hygienics of the human vision. However, in most class-rooms it would be easy to make the necessary alteration—to have the light come from the left-hand side, and, by raising the benches one above the other, or, simpler still, by sufficiently raising the master's place, to enable the teacher to survey the whole class at a glance.

I am afraid my advice in this matter will not soon be practically followed, as even in Europe only after years of urging and preaching have the necessary alterations been made in schools; but my paper has at least drawn attention to the matter, and it must rest in the future what fruit it will bear.

ART LX.—*On the Constitution of Comets.* By the Rev. P. W. FAIRCLOUGH.

[Read before the Southland Institute, 10th October, 1882.]

KEPLER, with the prescience of genius, supposed that comets throng in space as fish in the sea. It is true that only some 650 comets are recorded as seen during the Christian era, and that a considerable number of these have been reappearances of periodic visitors. But of these 650, about 120 have been seen in the Nineteenth Century,—mostly telescopic, however. This large number is owing to improved methods of observing. As many as eight have been seen in one year, and we have in our morning sky the fourth for the year 1882. Now, it is certain that not half the comets that approach the sun, within the range of the telescope, are seen by man. It may also be regarded as highly probable that vast numbers of comets have their perihelia at distances which preclude their discovery.

A comet crossing the solar frontier with the momentum of a few miles per annum, along a line forming an angle of 45° with the radius from the sun's centre to the comet's centre, at the moment of crossing, would secure a perihelion distance of many millions of miles. If, however, the momentum amounted to miles per hour, the comet would be carried far too wide of the sun to be observed by the inhabitants of the earth.

As, therefore, it is probable that comets enter the sun's domain with a great variety of momenta; and as, in the case of any particular comet, the probabilities are many millions to one against its momentum being in the direction of the little point represented by the sun and the planetary orbits, it is extremely probable that the great majority of visitors from interstellar space never come within human ken.

Let us suppose that, for every comet seen, nine others make their perihelion passage unobserved. Of 200 comets, the elements of whose orbits have been ascertained, twenty per cent. belong to the solar system, and eighty per cent. were visitors for the first and last time. If, therefore, astronomers record on an average one comet *per annum*, and nine others pass unrecorded, and if of these ten, two belong to the solar system, and eight are strangers, how great must be the wealth of cometic matter in the universe! For as these strangers are supposed to be some 5,000,000 years in the sun's dominions before making their perihelion sweep, it is evident that at any moment the sun must have, under his control, a supply of foreign comets for 5,000,000 years, at the rate of eight *per annum!* That is 40,000,000; besides vast multitudes of comparatively domestic comets, to whom he saith "Go," and they go; "Come," and they come.

If, then, each sun of the midnight sky, and of the astronomer's "optic tube," can boast such a following of comets, it shall come very near to be thought that the objects so long beheld with terror, on account of their rarity, are, indeed, the most numerous family of bodies in the universe.

Comets are among the very few celestial objects that are waiting to be explained, and although the question of their constitution, like the secret of the Pole, is of no practical importance, it is yet of absorbing interest. The solution, however, of many of the questions that may perplex us to-night may already be in the hands of those fortunate scientific men whose position has enabled them to analyze our present brilliant visitor with first-class spectroscopes.

For ages comets were regarded as vapours, and exhalations, more or less pestilential, floating in the atmosphere. Tycho Brahé was the first to rise to the conception that comets were beyond the moon.

Kepler's theory was wonderfully acute, considering the information at his disposal. He considered comets to be wholly or principally gaseous, and that the tail consisted of gaseous material, highly rarefied by the sun's heat, and then carried away by the repulsive force of the sun's rays. Others supposed the tail to be a column of vapour lighter than the medium in which the comet moved, and therefore raised, as smoke is raised in the column of heated air from a chimney. Newton supposed comets to have

considerable solid nuclei, calculated the heat to which the body of his comet (1680) was raised, and how long it would take to cool, on the supposition of its being as large as the moon. Another astronomer has calculated the effect upon the earth's orbit of a comet, with three times the mass of the earth, passing within 40,000 miles of her. Maupertuis sought to relieve the popular dread of collision by the suggestion that it might only destroy a part of the terrestrial surface, and that those who survived the shock might find the *débris* of the comet to consist largely of gold, diamonds, and the like. Boyle, however, the celebrated French philosopher, published a treatise in 1680 setting forth 239 elaborate reasons why comets could neither do or presage evil to the earth.

The popular idea of a comet, is a star with a tail! But a tail is only a temporary appendage to those that have it, while multitudes exhibit no tail. A constant characteristic of comets must be sought in the path pursued, rather than in any appearance presented to the eye. Some comets have been seen that could at times only be distinguished from stars by their course. Others present a star-like nucleus, surrounded by a coma, or a vast nebulous atmosphere. Donati's comet (1858) appeared to have a nucleus, or pellet of light, 1,600 miles in diameter. This was surrounded by two envelopes, one 7,000 and the other over 12,000 miles, high. The whole diameter of the head was 26,400 miles. Other comets, again, present only a nebulous mass, somewhat condensed at the centre, owing, probably, to the greater depth of matter.

Whether the nucleus is solid opaque matter or not, is, perhaps, an open question. Some observers, in the last century, supposed that they saw phases in certain nuclei, similar to those of the moon. But this was, perhaps, the result of earnest expectation and of devotion to a theory. More recent observers have not obtained similar results, and the spectroscope, as applied to several faint comets, seems to show that the nucleus does not shine by reflected sunlight, but has some apparently native luminosity. The tail, however, and the outer envelope of the head shine by reflected light. Some observers declare that they have seen stars through the nucleus, while others say they have seen stars occulted by the nucleus. It must be observed here that a bright nucleus would obliterate a small star by its very lustre, whether transparent or not. Through comets with purely nebulous heads, stars have certainly been seen. Sir J. Herschell declares that he has seen stars of the sixteenth or seventeenth magnitude, that a breath would obscure, through fully 50,000 miles of cometic matter. Compared with this extreme tenuity, this almost spiritual subtilty, the highest and most feathery cirrhus of our atmosphere may be regarded as dense and solid.

It is also worthy of note, that stars seen through comets have neither been displaced nor distorted, showing that the cometic matter has no refracting power.

Another argument against the solidity of comets is, that two at least have been placed in the scales, and found to be practically imponderable—weighed in the balance, in fact, and found wanting. In 1770, Lexall's comet plunged through the system of Jupiter, passing between the planet and one of its moons. The comet was whirled into a new orbit, but the circular motion of Jupiter's moons was not in the least degree interfered with. As if to make assurance upon this point doubly sure by an experiment with the smallest planet, as well as with the largest, Encke's comet passed very near to Mercury some years ago, and was deflected from its course, affording a new and accurate measure of the mass of the planet. But Mercury himself was not in the least degree perturbed. This proves that the mass of a comet is quite insignificant.

It may also be noted that in 1846 Biela's comet divided into two, a greater and a lesser. These gradually parted from each other during thirteen years, in which period they made the circuit of their orbit twice. No perturbations were observed, to indicate that they sensibly attracted each other, and to give a clue to respective masses. With regard, then, to these three comets at least, the more general dictum of a philosopher of no low degree seems to be probable, "that the solid matter of a comet might be put into a gentleman's snuff-box."

If there be any resisting medium in the inter-planetary spaces, it is evident that vast, and almost imponderable bodies, like comets, would be the first to show in their motions the effects of it, just as a light object thrown through the air will show the resistance of the air far more clearly than a dense and heavy object. Encke's comet is one of the several short-period comets now known. It was discovered in 1789, and has now made twenty-seven revolutions since its discovery. Each one has shown itself to occupy on the average about two hours and a half less than its predecessor, so that the comet now comes to its perihelion some five or six weeks earlier than it would have done according to the period it observed at the time of its discovery. The fact that a number of eminent astronomers have attributed this effect to a resisting medium in space, is proof that no other sufficient cause is known to science. I am not aware that any other cause, with any degree of probability in it, has been assigned by any authority.

Should it be proved that the comet is really describing a spiral course, the vortex of which is the sun, it will simply suggest to the mind how, in unimaginable years, the solid planet must sink into that vortex too. At the same time be it noted that, if a comet should ultimately prove to us

that there is a resisting medium in all space, comets do now prove far more clearly, by the astounding velocity that their attenuated substances attain, how nearly absolutely empty space must be to admit of their motion.

However great the tenuity of the substance of comets, there is a point in each one which rigidly obeys the law of gravitation. This point is the nucleus, or centre of the head. A considerable number of short-period comets have the time of their perihelion passage fixed almost as accurately as the time of an eclipse. Halley's comet, observed in 1682, was predicted to return in 77 years. Computists calculated the retarding influences of the known planets, and allowed 30 days for possible error in the time fixed by them for the perihelion sweep. Neither Uranus nor Neptune were then known, yet the comet was in perihelio in 1756, within 29 days of the time fixed. For its return in 1835—the planet Neptune being still unknown—the perihelion passage was fixed by Rosenberger between the 11th and the 16th of November. It took place on the 15th.

It is evident, therefore, that however small the mass of the huge volume of a comet, it yields the same obedience to law as the densest planet.

But a question naturally rises in our minds as to how the great body of a comet is held together, when its own power of gravity is known to be so small. If the difference of the distances of the centre and the surface of the minute and dense earth from the sun suffices to raise a considerable tide, we might naturally expect to find a comet, with its tremendous diameter, its small power of cohesion, and its proximity to the sun, rent into several sections, to be thrown into somewhat different orbits. The fact remains, however, that no such disruption takes place in the majority of cases; though there are several records of comets parting into two or more fragments.

But a curious phenomenon *is* observed upon the approach of a comet to the sun; it is that the nucleus appears to shrink in a wonderful degree. M. Struve, in observing Encke's comet in 1828, found that on December 24th it only occupied $\frac{1}{16000}$ part of the space it had occupied on the 28th of October. When it begins to recede from the sun, the comet begins also to recover its former volume. In this situation Halley's comet was observed by Sir J. Herschel, in 1835, to increase forty-fold in apparent size in a single week.

Several explanations of this have been given. A recent one is that of M. Valz, that the shrinking is due to the pressure of the sun's atmosphere. This theory, however, assumes an enormously extended atmosphere for the sun which can scarcely be granted; it also seems to require the comet to be enclosed in an envelope, to prevent it from mingling, like vapour from an engine, with the supposed atmosphere; it also supposes the comet to move

in a medium more dense than itself, which is utterly out of the question. The most probable theory is that which ascribes the change in apparent bulk to the powers of the sun's rays to rarefy, distend, and render invisible a large portion of the comet, which portion, upon reaching a cooler region, begins again to condense like an evening cloud.

Indeed, the extremes of heat and cold to which comets are subjected, render it easy to conceive of almost any change in their appearance. Even in the case of Halley's comet, the heat and light of perihelion are to the heat and light of aphelion as 3,000 to 1. But that comet does not pass very near the sun (54,000,000 of miles), nor recede much beyond the orbit of Neptune. But the comet of 1843, like that of 1882, passed within 30,000 miles of the sun's surface. Newton supposed his comet was subjected to a heat 2,000 times greater than that of red-hot iron. But the heat endured by the body mentioned must have exceeded this by about twenty-fold (for Newton's was 130,000 miles from the solar surface). This is a heat at which, of course, any terrestrial substance would be volatilized. On the other hand this same body will wander to regions where, under similar conditions, it would only receive one four hundredth part of the light and heat enjoyed by the earth.

May it not be that such extremes of heat and cold, together with the almost total absence of pressure, produce conditions of matter unknown and unknowable to us? And may not these unknown and unknowable conditions lie at the bottom of some of the problems that are so perplexing to the human mind?

Yet, something is certainly known of the constitutional elements of a few comets. The spectroscope has shown the nucleus, or central part of the head of one, to be luminous gas; while the outer part of the coma shone by reflected light. Another comet was found by Dr. Huggins to consist of *volatilized* (not *burning*) *carbon*,—the lines in the cometic spectrum agreeing exactly with the lines due to carbon in the spectrum of olefiant gas. This discovery, however, can only be regarded as adding another to the many problems connected with comets; for carbon is notable for its fixity at moderate temperatures, and the comet in question was in a temperate region of space. Comets examined since 1868 show hydrogen and other elements associated with carbon.

A peculiar relation is known to exist between comets and meteor systems, but it is still involved in obscurity. No less an authority than J. C. Adams, the English discoverer of Neptune, has computed the orbit of the November meteors and shown that they pass beyond the planet Uranus, and have a period of 33¼ years. He assigned to them exactly the same path as that already assigned to Temple's comet! It is probable that the

whole of the vast orbit is peopled by flights of meteorites in endless chase, and that the comet, as the *gem* of the ring, moves round preceded and followed by a retinue of cosmic chips. That all comets are associated with meteors, though fairly probable, cannot be confidently asserted.

I must now come to the most difficult, but also the most fascinating, part of the subject—the so-called tail of the comet. When this appendage is shown at all, it is only while comparatively near the sun. A comet may develope a tail in approaching the sun and show none after perihelion; or it may only develope tail after perihelion; or it may show one both before and after; or neither before nor after.

The nucleus of a comet is separated from the coma by a dark ring, as the sunlit surface of a cloud might be separated from the earth by a band of invisible air. The nucleus is similarly parted from the tail, which appears to be an extension of the coma in the direction opposite to the sun. The *nose* of the comet is like the flame of a torch blown back by the wind, or like the apex of an upright jet of water from a fountain, where the liquid turns to fall back. The theory now very generally accepted by astronomers is that for some kinds of matter, or for matter in certain conditions, the sun has a repulsive force far more potent than his power of gravity; that, under the influence of intense heat, jets of volatilized matter are thrown out, perhaps in all directions, but certainly towards the sun; that presently the repulsive force overcomes their forward motion, turns them back, and sweeps them away into space until the particles are so widely dispersed as to be invisible.

It was at one time hoped that Mr. Crookes' radiometer was about to show us the repulsive force of the sun's rays at work in our very hands; but the dream vanished, and the repulsive force is still theory, although Sir J. Herschel declares it is proved beyond question by his own observations and those of others. This theory also explains some other phenomena, as the curvature of the tail, and the fact that the convex side of the tail is the brightest and least curved. The convexity of the tail is always towards the direction of the comet's motion. This has led to the gross idea that, like the smoke of a steamer, the tail was retarded by the medium in which the comet moved.

If we conceive of a comet being a rigid body, and that the tail is swung round as a walkingstick might be brandished by the handle, it will be evident that the end of the tail will have much further to travel than the head. But when matter is repelled from the nucleus, and from the sun, it has exactly the same forward momentum as the nucleus; as, therefore, it is driven further and further from the sun, and has a larger and larger orbit to describe, it of necessity falls behind, and cannot therefore be swung

round like a stick, but only like a jet of water from a hydrant. The curvature would, therefore, afford data for finding the velocity with which the repelled matter was driven off.

Again, the convex, or front side of the tail is brightest and straightest. In Donati's comet, 1858, small straight tails preceded the main tail.

One explanation serves for all these facts. The sun analyzes the matter of the comet. Some parts of it he can dart away at an incomparably higher velocity than others. This matter, most swiftly ejected, either makes separate straight tails, as in 1858, or somewhat straightens and brightens the convex, or front, side of the main tail.

There is much room for speculation and enquiry in connection with this repulsive force. Does it pursue the repelled matter, and drive it away with an ever-increasing motion, so that it will leave our system altogether, or does it give an initial impulse, and have done? Will the repelled matter change its condition by cooling, and cease to be liable to the persecution of the repelling force? Or has it lost its affinities and the power of changing its condition? Whatever may be its destiny it is certainly divorced from the comet for ever.

There is reason to suppose that all the matter of a comet is not susceptible to this repulsive force, and that a sufficient number of perihelion passages will sift all the susceptible matter out, and leave the comet incapable of producing a tail. Hence almost all the short-period comets that are in perihelio every few years are tailless; while visitors from the eternities of space, who can only be in that sifting position once in ten or twenty millions of years, frequently make a prodigious display of tail.

Art. LXI.—*Macquarie Island.* By John H. Scott, M.D., F.R.S.E., Professor of Anatomy and Physiology in the University of Otago.

[*Read before the Otago Institute, 21st June, 1881 and 9th May, 1882.*]

Plate XXXIX.

In most of the maps which I have seen, an island named "Emerald" is put down in latitude 57°, a long way to the south of Macquarie Island. This, is, however, now generally regarded as mythical, for its supposed site was sailed over by the American Transit of Venus Expedition and no land was observed. In all probability its discoverers mistook an iceberg for snow-covered land, a not unlikely mistake in misty weather.

We may therefore safely consider that Macquarie Island is the most southerly island of the outlying members of the New Zealand group, indeed,

with the exception of some of the islands in the neighbourhood of Cape Horn, it is the nearest point of land to the great Antarctic Continent. It lies considerably to the south of Kerguelen Land, or the Crozets.

On this account then considerable interest attaches to it. I therefore availed myself of the opportunity offered me by Messrs. Elder and Nichols, in the latter end of 1880, for a trip down to it in the "Jessie Niccol" schooner. It is the results of this excursion that I propose to give in this paper.

The changes which the New Zealand flora undergoes in the Auckland and Campbell Islands have been often noted, but almost nothing was known of its characters in Macquarie Island. I wished to notice how many plants survived in that high latitude, and what changes in appearance and habit these had undergone in suiting themselves to the rigorous climate; whether our New Zealand alpine forms were to be found there at the sea level, and whether there were to be found any new forms unrepresented even in the highest and most remote parts of New Zealand.

Four or five of the Macquarie Island plants had been sent to the Hooker Herbarium by Mr. Fraser, of the Sydney Botanic Gardens, about fifty years ago. I cannot, however, make out whether he had visited the island himself, or whether one of the sealers had brought the plants to him.

I was also anxious to see and study, so far as practicable, the sea elephants, which make it their summer resort. They never, so far as I know, come as far north as either Campbell Island or the Auckland group, so in this part of the world Macquarie Island is the only place where they can be observed.

Macquarie Island lies about 600 miles to the south-west of New Zealand, more than twice as far away as the Auckland group, and is separated from that group and from Campbell Island by very much deeper water than that which lies between them and New Zealand. There is a great valley 3,000 fathoms deep between Macquarie Island and the Auckland and Campbell Islands, while the sea between them and New Zealand is not 1,000 fathoms deep.

It is wrongly put down on all the charts. For the following correct position I am indebted to Captain Cowper, who, in the "Jessie Niccol," has made a number of trips to the island:—

Latitude, north end, 54° 26′ South.
Latitude, south end, 54° 44′ South.
Longitude, north end, east side, 159° 5′ 45″ East.
Longitude, south end, east side, 159° 1′ 45″ East.

It is about 18 miles long and 5 miles broad, its east side lying N. ½ W. and S. ½ E. magnetic.

It is a solitary island, but it has two outlying rocks. One called the "Bishop and Clerk" lies 30 miles to the south of the south end; the other called the "Judge and Clerk" is 7 miles to the north of the North Head.

It is exceedingly hilly. The hills, however, are of no great height, not more than 600 or 700 feet I should think. They rise as a rule almost directly from the sea, leaving but a narrow interval of shingly beach, while occasional spurs run out from wide open bays which afford no shelter to vessels. Towards the north end of the west coast there is a greater extent of flat land between the hills and the sea. Between the steeper part of the hill-side and the shingle, there is always a more gently sloping belt of extremely swampy land. And here the tussock grass grows in "Maori heads" above the soft treacherous mud. At both ends of the island, however, the land rises in cliffs abruptly from the sea; and the North Head forms a bluff distinct from the rest of the island, and only connected with it by a narrow neck of sand, through which the sea in stormy weather has been known to break.

The west coast is, as might be expected, more cut into by the sea than the east, but there are no bays suitable for harbours. At the south-west corner of the island, there is, indeed, a beautiful deep bay called "Caroline Cove," completely sheltered from every side except the south-west. It is completely open to that quarter however, and as the prevailing wind blows from the south-west, and therefore straight into the bay, it would rather prove a trap than a shelter to any vessel that anchored in it. There are still visible on the beach the remains of a vessel which was wrecked in this manner. The sealing vessels always lie some distance off the coast ready to slip and go to sea at any moment. The oil in large casks is floated out to them.

The Caroline Cove wreck is not the only vessel that has gone ashore on Macquarie Island; and there are still to be seen the graves of some of the shipwrecked seamen. On the bit of plank which served as headstone for one of them I was able to decipher the name, John Bilsham, but the date was illegible.

The interior of the island shows the rocky tops of the hills blown perfectly bare by the wind, and fissured by the frosts; and in the hollows of the uplands lie a number of little lakes, which empty themselves by streams. These either make valleys for themselves down to the sea, or tumble down the steep hill-sides in miniature cascades.

The general appearance of a Macquarie Island landscape is barren in the extreme. There is not a tree or shrub on the island, and what vegetation there is has a great deal of sameness, long stretches of yellowish tussock, with occasional great patches of the bright-green *Stilbocarpa polaris*, or of the peculiar sage-green *Pleurophyllum*. These, with the rich brown

mosses near the hill-tops, are all that strike the eye in looking at the island from the sea. This paucity of species is, as we shall see again, one of the characteristics of the flora of antarctic islands.

The rocks of the island belong to the older crystallines, greenstones. They have occasionally an amygdaloidal structure, the amygdules sometimes containing zeolites. Mesotype, with concentric radiated fibrous structure, occurs in one of my specimens; and in another, what is probably analcime, is to be seen. The rocks are sometimes veined with quartz.

BOTANY.

Unfortunately the season at which I visited the island was not well suited for collecting plants. I was there in November and in these latitudes spring is but little advanced in that month. I therefore found comparatively few plants in flower. This of course has added much to the difficulty of identifying my specimens, and combined with the thick weather has helped to make my collection smaller than it might have been under more favourable circumstances. There are certain plants, common in the Campbell and Auckland Islands, which may, for these reasons, have been overlooked by me in Macquarie Island, such as the *Anthericum rossii*, a lily, whose golden flowers are said by Hooker to form a very striking object in a Campbell Island landscape; if present, however, it cannot be at all common. Another genus which one might expect to find, but which I did not meet with, is the *Veronica*. A plant so common in New Zealand and in the Campbell and Auckland Islands, at all elevations, ought surely to have some representative in Macquarie Island. I have little doubt but that my collection is imperfect, but even allowing largely for that, it shows that many species have disappeared which are common in the Auckland and Campbell Islands, and that those plants which are present have a much more stunted growth.

Those plants I did collect, however, are, with one exception (the *Azorella selago*), distinctly New Zealand in their characters, quite as much so as those belonging to the Auckland or Campbell Islands; and they also show that all these islands agree in having, in common with all other antarctic islands, a flora characterized by few species, but what there are, growing luxuriantly. This is very distinctly seen in Macquarie Island, where the number of species of flowering plants is certainly most limited, but where great areas are covered by a close growth of *Stilbocarpa* and *Pleurophyllum*.

It is curious to contrast the poverty of Macquarie Island in flowering plants with the richness of countries in the northern hemisphere. The corresponding north latitude runs through the north of England; and even in islands in very much higher north latitudes, such as Spitzbergen, this greater richness in their flora is to be observed.

I have to thank Mr. A. C. Purdie for the trouble he has taken in the naming and arranging of my plants.

The following is a list of the plants collected, with the natural orders to which they belong. None of them are new to science; I have therefore not thought it necessary to give any detailed botanical descriptions.

RANUNCULACEÆ.

1. *Ranunculus* (*acaulis ?*), not in flower. Found in damp places. Occurs in New Zealand, and Auckland Islands.

CARYOPHYLLEÆ.

2. *Colobanthus muscoides*, not in flower. Found on rocks near the sea. Occurs in New Zealand, Auckland Islands, and Campbell Island.

ROSACEÆ.

3. *Acæna* (*buchanani ?*), not in flower. Found on the hillsides.

4. *Acæna ascendens*, Bidibidi [Piripiri], in fruit. Found on the hillsides. Both of these common in New Zealand.

CRASSULACEÆ.

5. *Tillæa sinclairii*, in flower. Found in damp places. Occurs in New Zealand, Auckland Islands, and Campbell Island.

UMBELLIFERÆ.

6. *Azorella selago*, not in flower. This is a rare and peculiar plant. It does not occur in New Zealand, and has never been observed in either the Aucklands or Campbell Island. It grows on the hillsides, forming prominent globular masses often 4 feet across. These are green on the surface, where the living part of the plant lies as a crust to the great mass of débris which forms the interior. This is the decaying remains of former years' growth, through which the roots descend. The whole makes a solid mass on which one can stand. The surface crust is particularly dense. The young shoots are so closely packed together and make so uniform a surface, that lichens and other small plants are sometimes found growing on it.

This same plant is best known from its occurrence in Kerguelen Land and the neighbouring islands. There it grows more abundantly. It is also said to occur among the mountains of Fuegia.

7. *Azorella lycopodioides* (?), not in flower. Grows in small masses. It has often been confused with *Colobanthus subulatus*, and as my specimen has neither flowers nor fruit it is named with some diffidence.

ARALIACEÆ.

8. *Stilbocarpa polaris*, "Macquarie Island Cabbage" of the sealers, in flower and fruit. This plant is found all over the island growing in large patches. In sheltered corners on the lower ground it is a handsome plant, and its bright green leaves are always conspicuous.

In last year's Transactions Mr. Armstrong described two varieties from Stewart Island, one of which had hairy the other smooth leaves; and last summer these two varieties were brought up from Auckland Island. I did not notice the smooth-leaved variety on Macquarie Island.

This is a very common plant in both the Campbell and Auckland Islands. It is also found in Stewart Island, and Lyall has found it on the west coast of the South Island of New Zealand. What is known as the "Kerguelen Cabbage" is an entirely different plant—the *Pringlea antiscorbutica*."

RUBIACEÆ.

9. *Coprosma repens*, not in flower. Found in New Zealand, Auckland and Campbell Islands.

COMPOSITÆ.

10. *Pleurophyllum criniferum*, in flower and fruit. This, like the *Stilbocarpa*, occurs in large patches all over the island. It is the handsomest plant on the island. Its long sage-green leaves and its purple flowers make it particularly noticeable. It occurs in the Auckland and Campbell Islands and there grows much larger, becoming a much more showy plant.

11. *Cotula plumosa*, in flower. Occurs plentifully close to the sea. It is very rare in New Zealand, but has been found in Otago.

JUNCEÆ.

12. *Luzula crinita*, in damp places. Occurs in New Zealand, and in the Auckland and Campbell Islands.

13. *Luzula campestris.* Occurs in New Zealand.

GRAMINEÆ.

14. *Poa foliosa.* The ordinary tussock of the island. It differs a good deal in appearance at different levels, and in swampy and dry ground. Occurs in New Zealand and in the Auckland and Campbell Islands.

15. *Poa annua.* Found near one of the huts. Possibly introduced.

16. *Festuca duriuscula.* Differs from Buchanan's figure of this plant in having the inner empty glume bifid at the extremity, not acute as given by him.

FILICES.

17. *Aspidium aculeatum* var. *restitum.* Occurs occasionally not far from the sea, and grows to a fair size. Common in New Zealand, and in the Auckland and Campbell Islands.

18. *Polypodium australe.* My specimens show an extremely alpine form of this fern. It is a very common New Zealand fern, but is not mentioned in Hooker's "Flora Antarctica" as growing on the Auckland or Campbell Islands.

19. *Lomaria alpina*, also common in New Zealand.

MUSCI.

20. *Dicranum robustum.*
21. *Dicranum menziesii.*
22. *Batramia elongata*, mixed with a *Jungermannia.*
23. *Racomitrium lanuginosum.*
24. *Andreæa mutabilis.*
25. *Zygodon*, sp.
26. *Trematodon flexipes.*
27. *Campylopus introflexus.*

LICHENES.

28. *Stereocaulon ramulosum.*
29. *Sphærophoron coralloides* (?).
30. *Cladonia cariosa.*
    ,, *pyxidata.*
31. *Parmelia parietina.*
32. *Lecanora parella.*
33. *Lecidea coarctata.*

FUNGI.

34. *Uredo antarctica*, growing on the stems of *Luzula crinita* and *campestris.*

35. *Sphæria phæosticta*, growing on the stems of *Luzula crinita* and *campestris.*

36. *Sphæria herbarum*, growing on *Poa foliosa.*

37. *Sphæria depressa*, growing on *Poa foliosa.*

38. *Hendersonia microsticta*, growing on the dead stems of *Stilbocarpa polaris.*

39. *Dothidea spilomea*, on dead stems of *Stilbocarpa polaris*, and of *Pleurophyllum criniferum.*

The plants which were sent by Fraser to the Hooker Herbarium are:—

1. *Acæna sanguisorbæ.*
2. ,, *ascendens.*
3. *Pleurophyllum criniferum.*
4. *Cotula plumosa.*
5. *Poa foliosa.*
6. *Azorella selago.*
7. *Luzula crinita.*

BIRDS.

The most common birds on the island are the penguins. Of these there are four different kinds occurring, either separately or mixed, in rookeries scattered at intervals all round the coast. They were all incubating at the time of my visit.

Aptenodytes pennanti, "King Penguin."—These build no nest. They lay their single egg anywhere in the rookery, often in running water, and sit over it, tucking it with their feet into the fold in the lower part of their abdomen. The egg is large and much pointed at one end. The young are almost as large as the adults, but are covered with a thick brown coat of down. A few of the females were sitting at the time of my visit. The King Penguins have not been known to migrate.

Eudyptes schlegeli, "Royal Penguin."—More numerous than the other varieties. They build a nest of stones, in which they lay three eggs as a rule. They are said to discard their first egg. The young are coloured like the adults with the exception of the yellow crest. The "Royals" leave the island in June, and return in October.

Eudyptes filholi, "Victoria Penguin."—These also build a nest of stones and lay two or three eggs. Their rookeries are generally among the rocks. The young are coloured like the adults, but have no crests. They, like the "Royals," leave in June and return in October.

Pygoscelis tæniala, "Rockhopper."—A name much more suited to the "Victorias" than to this variety. They have their rookeries amongst the tussock and build nests of grass. Their eggs, of which there are generally two or three, are generally much rounder than those of the other penguins. The young are coloured like the adults. They have not been known to migrate.

Ossifraga gigantea, "Nelly," "Stinkpot."—Lives in rookeries, generally inland. Builds grassy nests, in which are usually two eggs. The females were sitting at the time of my visit.

Phalacrocorax carunculatus, Shag.—Was also incubating. Dr. Buller, who saw my specimen, named it as above.

Prion banksii, "Night-bird."—Makes its nest in burrows under the tussocks, where it can be heard during the day cooing like a dove. It leaves its nest at night and picks up its food at sea, a short distance from the land.

Platycercus novæ-zealandiæ, Parroquet.—Same as New Zealand form. Occurs in great numbers round the shore. Makes its nest under tussocks.

Ocydromus, "Maori Hen."—I only saw one specimen of this bird. Its plumage was of a bright reddish-brown colour.

Rallus macquariensis.—Much smaller than the "Maori hen," and not at all uncommon. There seemed to be two varieties—one, slightly the larger, was reddish in colour, the other was black.

Lestris antarctica, "Sea Hen," "Skua Gull."—Most of the eggs of this gull are hatched by the end of November. The nests are, as a rule, at a considerable elevation above the sea. The adults are as savage and predatory as they are in other parts, and it is not quite safe to go inland without a stout stick.

I did not see any nests of the ordinary white gull, which is also common on the shore.

The sealers told me that teal were occasionally seen on some of the little lakes among the hills. I did not, however, see any.

I was also informed that an albatross nest was once found on the high land towards the south end of the island. This was some years ago, and none had been observed since then.

Mammals.

There are no land mammals peculiar to the island, but the ubiquitous rabbit was introduced a few years ago, and now swarms at the north end, where it feeds largely on the thick fleshy roots of the *Pleurophyllum*. Very few rabbits were originally landed, and these, I was told, were all of the tame parti-coloured kind. It was curious to observe how their descendants, in the process of reverting to the wild type, had all become one-coloured—black, or white with pink eyes, or yellow—while many had become regular wild rabbits in colour as well as habits.

Morunga elephantina, "Sea Elephant."—This is the largest of the seals, and receives its name of "elephant" from the curious manner in which it elongates its nose when excited or angry. It is regularly hunted for its blubber, which forms a thick layer underneath the skin. Macquarie Island is the only place near New Zealand where these elephants are found, but they are common on the shores of Kerguelen Land and the neighbouring islands, and occur even as far north as Juan Fernandez.

I judged some of the larger males I saw to be over 20 feet long. The females, however, are very much smaller. They are thick in proportion and are huge unwieldy creatures.

The usual colour is a yellowish-brown, some, however, are redder in colour. The young ones are almost black. For about one week after their birth they retain a beautifully soft furry coat, also black in colour.

The main peculiarity of these creatures is the mobility of the nose. This, when the animal is asleep or undisturbed, presents no peculiarity. Irritate him, however, or see him naturally excited, and you will soon see the curious change which rage produces in his face. He invariably, however young, rears himself, sometimes at both ends, and opens his mouth to its fullest extent, showing all his teeth and uttering a peculiar barking roar. At the same time the nose in the adult males undergoes its peculiar change. It is, partly by air being blown forcibly into its elastic-sided cavity and to a certain extent by muscular contraction, puffed out in great sacs above the animal's head. It elongates as well as swells, and hangs down as a trunk for some inches in front of its mouth. None of the plates of sea-elephants which I have seen, represent this nasal swelling at all as it is. I was fortunate enough to see two large ani als thoroughly angry.

MACQUARRIE ISLAND.

Dr. Scott, del. J.B. lith.

I was not able to observe much of this animal's habits during the few days I spent on the island. I usually saw them lying asleep in groups on the shingle, or in the long tussock near the beach. I sometimes saw them gambolling in the shallow water among the kelp, and occasionally I noticed them fighting in a half-hearted sort of way. The scarred hides and broken tusks of the old males, however, show that they sometimes have savage encounters. In fighting they rear themselves against each other and try to seize their opponent with their large canines. These are the only teeth they could use for such a purpose, as the others barely pierce the gum. They are never to be seen feeding on the island, and during the breeding season live on their own fat. Little or nothing in the way of food is ever found in their stomachs, but these and the intestines are infested with parasitic worms.

The island is never entirely deserted by the sea-elephants, but by far the greatest number are to be found after October, when they come up to calve.

The period of gestation is said to be eleven months.

The cows, I was told by the sealers, suckle their young for three weeks, and then wean them by deserting them for a time. Whether this be the case or not I cannot say, but I certainly often saw very young animals lying on the beach apart from the adults.

The sealers say that a bull is not worth killing for its blubber till it is three years old.

The tongue of these animals when well cooked is excellent eating.

No fur seals are found on Macquarie Island, though they are so common on the Auckland group.

The only other seal is the *Stenorhynchus leptonyx*, or sea-leopard, the ordinary spotted seal of our coasts.

It is a great contrast to the sluggish sea-elephant, and is the terror of the penguins.

ART. LXII.—*Is New Zealand a Healthy Country?—An Enquiry.*

By ALFRED K. NEWMAN, M.B., M.R.C.P.

With Statistics by F. W. FRANKLAND.

[*Read before the Wellington Philosophical Society, 3rd February, 1883.*]

THAT "National health is national wealth," has become a firmly fixed article of belief among all modern thinkers. Much has been written upon the resources of New Zealand: authors have described in glowing words its boundless mineral wealth, and the luxuriant fertility of its rich soil. A few have touched upon the healthiness of the climate, but these latter have

made statements chiefly consisting of vague and shadowy beliefs, and not the results of patient enquiries. Upwards of forty years have come and gone since this colony was founded, and since 1874 the censuses have been so many and so accurate, and the population so large, as to afford us a sufficient supply of facts whereon to base the statements made by us. In the childhood of the colony several army surgeons collected statistics of the healthiness of the troops stationed in it, and compared these with those of our soldiers quartered in other parts of the globe. These statistics, though few, pointed strongly to the fact that the climate of New Zealand was good.

In conjunction with my friend Mr. Frankland I proposed to examine carefully what were the grounds on which this belief was based. We agreed to contribute a joint paper. Subsequently this plan was slightly changed, but the statistics in this paper were all supplied by him, and of their accuracy there can be no question. Mr. Frankland's great mathematical powers and his long and thorough acquaintance with the vital statistics of the colony are an absolute guarantee of their correctness.

Any physician investigating the question whether this colony is or is not healthy, would make search for diseases, old and new; for diseases well known to him and for diseases hitherto unrecognized. He would draw up a list of prevalent diseases, just as a botanist or geologist would prepare lists of plants and rocks.

Subjoined is a list (No. I.) of diseases known to exist in this colony and another (No. II.) of diseases not yet imported, whilst the last list (No. III.) shows the list of diseases peculiar to these islands. Though I have taken great pains and made many enquiries for the purposes of making these lists as accurate as possible, it must be remembered that no such lists as the first two can be perfect. Of one thing we are certain, viz., that all the diseases named in No. I. have actually obtained in New Zealand. It is possible that a few in No. II. may also have existed. These lists are compiled from various sources. The Registrar-General's returns are valuable only for diseases which *kill*; they take no heed of the others.

An examination of these lists shows us that people coming to this colony have no need to fear that they run a risk of catching *new* diseases, for the only indigenous diseases are the bite of the *katipo*, and very rare deaths from the eating of two or three different kinds of poisonous berries. From the Maoris, the original inhabitants, we have not acquired one single disease. They have not one new disease of their own. Earlier writers on the colony talk of a disease called *ngerengere*, but this is merely a variety of pure leprosy, which is common to all the Polynesian inhabitants of the Pacific isles. It presents no feature worthy of notice, except that it is fast disappearing, and is far less common now than it was forty years ago. Probably

there are not above twenty-five cases in all New Zealand. This disease has not been communicated to Europeans. It is true leprosy occurs in the colony, but it is the sporadic leprosy obtaining rarely in Great Britain.

The Maoris, the original inhabitants of these islands, never at any time formed a *dense* population, consequently the soil was never polluted with excreta and the dead as in older countries.

The European emigrants to these bountiful isles, come to lands free from any new disease, unfortunately they have brought most of their own, and in time will bring more; but it is a remarkable fact that in the country itself there is no new disease. Neither soil nor water, nor atmosphere, produce specific disease germs, or new diseases due to other conditions.

Had it been possible to maintain a rigorous and perfect system of quarantine, these isles might have been kept for ever free from typhoid, measles, and other zymotic diseases. It should be one of the chief aims of the Government and the people to prevent the introduction of those not yet brought hither.

LIST I.

DISEASES EXISTING IN NEW ZEALAND.

Zymotic Diseases.

Typhoid (under a variety of names, as swamp fever, colonial fever, bilious fever, gastric fever, low fever, diarrhœa, dysentery, and probably other *aliases*).

Measles.
Rotheln.
Scarlet fever.
Diphtheria.
Croup.
Erysipelas.
Hospital gangrene.
Puerperal fever.
Hay asthma.
Ague.
Chickenpox.
Cowpox.
Roseola.
Pertussis or whoopingcough.
Influenza.

Chest Diseases.

Phthisis, tubercular, fibroid, probably every variety.
Pneumonia, every variety.
Pleurisy, hydrothorax, empyema.
Bronchitis, all forms.
Asthma.

Constitutional Diseases.

Tuberculo
Struma.
Syphilis.
Rachitis.
Chronic rheumatism.
Rheumatic fever.
Cancer.
Gout.

Heart Diseases.

All forms.
Angina pectoris.

Kidney Diseases.

All known forms except parasites.

Suprarenal capsules.

Addison's disease.

Lymphatics and Spleen.

Lymphadenoma.
Hodgkin's disease.
Leucocythæmia.

Skin Diseases.

Acne.
Pemphigus.
Eczema.
Psoriasis.
Lupus.
Urticaria.
Mollusca contagiosa.
Lichen.
Impetigo.
Pityriasis versicolor.
Herpes.
Onychia.
Tinea, various forms.
Alopecia.
Lepra græcorum.
Ecthyma.

Parasites.

Ascaris vermicularis.
Demodex folliculorum.
Acarus.
Phthereasiasis.
Ascaris lumbricoides.
Tæna solium.
Hydatids.
Triocephalus dispar.

Nervous.

Insanity, every variety.
Epilepsy.
Diabetes.
Tetanus.
Paralysis agitans.
Chorea.
Facial paralysis, both varieties.
Apoplexy due to all known causes.
Locomotor ataxy.
Hemicrania.
Migraine.
Exophthalmic goitre.
Pseudohypertrophic paralysis.
Various forms of paralysis and paresis.
Insular sclerosis.
Scriveners' palsy.
Hysteria.

Uterine.

All the forms known to exist.

Liver Diseases.

Cirrhosis, common.
Tuberculosis.
Jaundice.
Calculus.

Miscellaneous.

Mollities ossium.
All common forms of bone and joint disease.
Meniéres' disease or labyrinthine vertigo.
Cataract.
Iritis, pustular corneitis.
Glaucoma.
Ophthalmia.
Dyspepsia, every variety.
All varieties of tumour.
Alcoholism.
Gonorrhœa.
Bubo.
Soft chancre.
Common catarrh.
Aneurism.
Laryngitis.
Goître.
Tabes mesenterica.
Diarrhœa.
Dysentery.
Sunstroke.
Scurvy.
Atrophy.
Dental affections.

LIST II.

DISEASES NOT KNOWN IN NEW ZEALAND.

Typhus fever.
Charbon.
Cholera.
Beriberi.
Pellagra.
Remittent or intermittent or starvation or relapsing fever.
Malaria.
Smallpox.
Ague, unless actually imported by the individual.
Dysentery, unless brought in the person of a sufferer.
Dengue.
Plague.
Aleppo or Delhi boils.
Guinea worms.
Yams or yaws.
Leucoma.
Yellow fever.
Trichinosis.
Madura foot.
Favus.
Malignant pustule.
Hepatic abscess.
Acute yellow atrophy of liver.
Elephantiasis arabum.
Trismus neonatorum.
Plica polonica.
Crétinism.
Zanthelasma vitiligoidea.
Hydrophobia.
Hydatid.
Equinia mitis or grease.
Diseases from manufactures, as Sheffielders' asthma, phosphorus necrosis, arsenical copper poisoning, &c.

LIST III.

DISEASES PECULIAR TO NEW ZEALAND.

Bite of katipo.
Disease among Maoris from eating excess of lampreys at wrong season.
Poisoning from karaka berries.
Cutaneous eruption due to rancid fat of pigeons, peculiar to Maoris.
Poisonous mushrooms.
Poison of tutu plant.
Gastric disturbances arising from the eating of half-dried semi-putrid eels and half-rotten maize, disease peculiar to Maoris.
Stroke of *Gymnotus electricus* (?)

REMARKS ON THE LISTS.

It has been stated that smallpox and typhus have both existed in New Zealand, and there are in the Registrar-General's reports lists of deaths due to the latter disease. After careful enquiry, I think that typhus, true typhus as English physicians call it, has not yet appeared. I think the statement that deaths arise from typhus is due to three causes: (1.) Errors in diagnosis. (2.) Inability to distinguish between typhus and typhoid by certain men on the register of practitioners. (3.) The fact that foreign doctors use the terms typhus and typhus abdominalis for the two diseases, and hence a not infrequent source of error.

About rotheln there seems some doubt.

Ague never springs up *de novo* in any one in New Zealand, it is always *imported* by the sufferer in *his own person*.

Other diseases, as beriberi, pellagra, cholera, yellow fever, starvation fever, have not yet shown themselves. True dysentery is, like ague, imported in the *person* of the sufferer and is not acquired in the colony.

The only epidemic diseases which trouble us are scarlet fever, typhoid, measles, diphtheria, croup, whooping-cough and influenza. Of these, scarlet fever epidemics are usually mild. Diphtheria is very common and fatal, as elsewhere. *Typhoid*, sometimes recognized and very often not, goes by many names, *e.g.*, colonial fever, low fever, gastric or bilious fever, blood poisoning, swamp fever, etc.. It is a pity that this disease is not called by the graphic name "filth" fever. It spreads so much because New Zealand colonists have scant objection to drinking diluted sewage or having reeking cesspits either directly under or close to their houses. Of this disease no more need be said; deaths and illness from it should not be charged against the climate or soil, but rather to the folly of the people.

Chest diseases.—Of all our diseases, phthisis is the worst, the most deadly. It is more prevalent and severe in the cold wet south than in the drier hotter north. Phthisical immigrants, whether in the north or south, invariably receive great benefit, and many are perfectly cured. As the immense majority of these immigrants come from Great Britain they find the climate most mild and soothing. Their coughs grow easier and less frequent; they gain weight and strength, and even those who are not cured almost invariably have their lives much prolonged.

The deaths from phthisis are high, partly because British physicians strongly recommend these patients to try our climate; but as against this increase we must put on record the fact that thousands of people were imported at public expense and from these many thousands all phthisics were excluded.

Among the New Zealand born, however, phthisis is rife and very fatal. Young colonists when attacked nearly always die.

Cardiac affections appear in the same proportions as in Great Britain.

Liver affections, so prevalent in tropical climates, are here unknown. The commonest form of liver disease is cirrhosis arising from abuse of alcohol.

Nervous disorders.—All forms exist except perhaps two or three of the rarer kinds. Insanity prevails largely; but statistics are not trustworthy, because the unfortunate practice long prevailed in this colony of sending to the asylums all persons suffering from *delirium tremens*, a class of cases which at home are treated in hospitals.

Parasites.—None peculiar to the colony have been observed. All have been imported. It is doubtful if the tapeworm has gained a hold on the colony. Like hydatid it is probably brought hither in the person of the

sufferer and is not acquired here. It is singular that hydatids should not exist here, for they are very prevalent in Australia, and dogs are numerous and live in intimate communion with man.

Skin diseases.—Owing to the well-to-do character of the people, the small amount of segregation and the abundance of good food, skin diseases are far less common in the colony than at home. A little acne, eczema or psoriasis and liver compose the bulk of the cases.

Constitutional.—The *tubercular* diathesis is abundant and perhaps assumes a greater prominence because the others are rarer. In young New Zealanders this diathesis far exceeds all the others. Struma exists but in modified forms. The population are so well off, and so abundantly supplied with good healthy food and ample shelter, and lead such healthy out-door lives that they beget a healthy offspring; and to this offspring they give the best of food and raiment. For the same reasons rachitis is but little seen.

Syphilis for some reason or other is of a very mild type. The true hard or Hunterian chancre is but seldom seen and when it is seen is usually imported. Though gonorrhœa is abundant and soft chancre not uncommon, the Maoris, who suffer much from gonorrhœa, very rarely present symptoms of syphilis.

Gout.—A rare disease; one which will probably be almost or quite unknown to young New Zealanders, who in appearance and build show scant tendency to the gouty diathesis, and in habits and mode of life do little to promote the spread of this most unnecessary malady. When gout does appear it is always in the person of an immigrant.

Rheumatism in all shapes is the great scourge of the colonist. Whether the wide spread of the disease and its severity is due to climate, or rather to the hardships and exposure of the settlers, is a question which can be solved only by time and the elimination of those things which specially tend to produce it.

Goitre appears in two mountainous districts. Tabes mesenterica, so-called atrophy, and other childish diseases of defective nutrition are comparatively rare, as is shown in the small mortality.

Dental affections.—The chief feature is the very rapid decay of the teeth, a decay which may be called almost universal among the New Zealand born. This premature decay is seen in the milk and permanent teeth. Its early beginning and its steady progress till all the teeth are affected leads to much pain and indigestion through "bolted" food. The early decay of both sets of teeth is one of the most noteworthy features in New Zealand medicine. I am quite convinced that statistics would show an amount of disease of the teeth that would startle European physicians.

Alcoholism is a disease that is happily dying out before the spread of civilization, the absence of hardships, the easy attainment of comforts, and the lessening dulness of colonial life.

Remarks on Diseases yet unknown in New Zealand.

A scrutiny of these last reveals the encouraging fact that New Zealand is as yet free from some of the most terrible curses which afflict the human race—viz., smallpox, typhus, cholera, plague, yellow fever. That all malarial fevers are absent. That no healthy inhabitant will get ague or dysentery or be infected by parasites other than those common in Great Britain.

Remarks on Statistical Tables. By F. W. Frankland.

"Frequent comparisons have been made between the general death-rate of New Zealand and the death-rates which obtain in England and other countries; and it has been sought to establish on the basis of this comparison the fact of the salubrity of this country. The fact that the annual number of deaths in New Zealand is 11 or 12 per 1,000 living, and that in England it is 23 per 1,000 living, has been held by some to prove that, whatever may be the reason, the human constitution resists death more successfully here than in the mother-country. Even so high an authority as Dr. Drysdale, who has done so much for the propagation of sound views on hygienic matters, appears to have recently fallen into this error. To expose the fallacy of the reasoning we have referred to, it is only necessary to point out that in every country the liability of an individual to death varies enormously according to the age of the individual. It is, in mathematical language, a *function* of the age.

"The liability to death is always very high during the first year of life, and decreases with great rapidity till the age of 10 or 12 is attained, when it reaches a minimum. The annual deaths among 10,000 children, aged about 10 or 12, would be fewer than those among 10,000 individuals at any other age of life. With the advent of puberty, the liability to death begins to increase, and, barring a short halt during the early period of manhood, it increases progressively, and with constantly augmenting rapidity, throughout all the rest of life, till in old age it is higher even than in infancy. It follows from this that the *general* death-rate of a country must depend on the distribution of the population according to age, and that, until this distribution is taken into account, it is absolutely valueless as a test of the real vitality of the inhabitants. A moment's reflection will convince the reader, and a very short consultation of statistical tables will bear the conviction out, that in New Zealand there is a much larger proportion of people at the younger and middle ages of life, than there is in an old and settled country like

England. The smallness of our *general* death-rate is, therefore, utterly inconclusive as a test of our real vitality, and it becomes necessary to ascertain the death-rate, not merely *en bloc*, but at all the separate ages of life. This has been done in the accompanying tables.

"So far as the present writer is aware, only one such comparison has ever been made before for this colony. It is contained in an article 'On the Additional Premium required for Residence in Foreign Climates,' by Mr. James Meikle, the eminent Scotch actuary, published in the nineteenth volume of 'The Journal of the Institute of Actuaries.' It may, therefore, be well to quote the words in which Mr. Meikle summarized the results he arrived at. 'From the Census Enumeration,' he says,* 'which gives the number of lives in existence in March, 1874, and from the number of deaths in the year 1873, I am enabled to show the rate of mortality during each quinquennium of life, and thus to eliminate the effect of immigration, and the consequent irregular distribution of the lives according to age, as compared with the population of this country. *The result compares favourably with any other table.*† It is very much lighter than either the H^m‡ or the Carlisle§. I have not made any adjustment of the figures in respect of the progressive increase of the population, or for the deaths being those for the year anterior to the census * * * *The results show an exceedingly light rate of mortality.*† When measured by the annual premium for a life assurance, I should imagine that the New Zealand rate would require about 7½ or 10 per cent. less premium than the H^m rate. Before, however, placing much confidence in the results, they would require to be verified at the next census.' The verification which Mr. Meikle here speaks of, we have now accomplished,—and more. It will be seen that we have included in our tables the results of the *three* last census years, namely,—1874, 1878, and 1881; and it is satisfactory to be able to point out that the larger data we have thus collected, fully confirm his conclusion as to the low rate of mortality which prevails in this colony."

* 'Journal of Institute of Actuaries,' vol. xix., p. 291.

† The italics are our own.

‡ A table founded on the experience of twenty British insurance offices, and accepted as the best exponent of the mortality of assured life.

§ A well-known table, accepted as a fairly good exponent of average mortality.

	Mean Population during 1874.			*Deaths during* 1874.					
				Actual No. of Deaths.			No. of Deaths per 100 living.		
Ages.	Persons.	Males.	Females.	Persons.	Males.	Females.	Persons.	Males.	Females.
All ages.	315,860.	180,139.	135,721.	4,161	2,366	1,795	1·317	1·313	1·323
Under 1	12,050	6,163	5,887	1,394	751	643	11·57	12·19	10·92
1 to 2	9,481	4,733	4,748	349	165	184	3·68	3·49	3·88
2 to 3	11,163	5,676	5,487	148	68	80	1·33	1·20	1·46
3 to 4	11,174	5,542	5,632	104	53	51	0·93	0·96	0·91
4 to 5	10,861	5,395	5,466	84	50	34	0·77	0·93	0·62
5 to 10	45,674	22,962	22,712	272	136	136	0·60	0·59	0·60
10 to 15	30,423	15,411	15,012	85	41	44	0·28	0·27	0·29
15 to 20	22,920	11,501	11,419	97	55	42	0·42	0·48	0·37
20 to 25	23,806	12,860	10,946	114	63	51	0·48	0·49	0·47
25 to 30	27,360	16,157	11,203	180	100	80	0·66	0·62	0·71
30 to 35	31,748	20,720	11,028	209	126	83	0·66	0·61	0·75
35 to 40	26,399	18,006	8,393	239	157	82	0·91	0·87	0·98
40 to 45	20,038	13,910	6,128	201	142	59	1·00	1·02	0·96
45 to 50	11,364	7,704	3,660	148	112	36	1·30	1·45	0·98
50 to 55	8,574	5,533	3,041	137	93	44	1·60	1·68	1·45
55 to 60	4,835	2,978	1,857	97	69	28	2·01	2·32	1·51
60 to 65	3,514	2,096	1,418	67	44	23	1·91	2·10	1·62
65 to 70	1,852	1,126	726	75	50	25	4·05	4·44	3·44
70 to 75	1,294	785	509	72	39	33	5·56	4·97	6·48
75 to 80	474	266	208	37	20	17	7·81	7·52	8·17
80 and upwards	227	115	112	39	21	18	17·18	18·26	16·07
Unspecified	629	500	129	13	11	2	..	..	..

Ages.	Mean Population during 1878.			Deaths during 1878.					
				Actual No. of Deaths.			No. of Deaths per 100 living.		
	Persons.	Males.	Females.	Persons.	Males.	Females.	Persons.	Males.	Females.
All Ages.	419,927.	233,875.	186,052.	4,645	2,719	1,926	1·106	1·162	1·035
Under 1	16,330	8,327	8,003	1,500	822	678	9·19	9·87	8·47
1 to 2	13,570	6,833	6,737	308	162	146	2·27	2·37	2·17
2 to 3	14,685	7,549	7,136	103	64	39	·70	·85	·55
3 to 4	13,474	6,746	6,728	75	35	40	·56	·52	·59
4 to 5	12,599	6,367	6,232	39	11	28	·31	·17	·45
5 to 10	60,389	30,205	30,184	176	92	84	·29	·30	·28
10 to 15	46,267	23,368	22,899	101	53	48	·22	·23	·21
15 to 20	33,684	16,682	17,002	95	47	48	·28	·28	·28
20 to 25	35,285	19,352	15,933	177	88	89	·50	·46	·56
25 to 30	34,936	20,244	14,692	203	113	90	·58	·56	·61
30 to 35	32,791	19,576	13,215	197	105	92	·60	·54	·70
35 to 40	32,916	21,160	11,756	298	195	103	·91	·92	·88
40 to 45	26,296	17,427	8,869	254	186	68	·97	1·07	·77
45 to 50	17,223	11,459	5,764	261	189	72	1·52	1·65	1·25
50 to 55	11,000	7,171	3,829	175	127	48	1·60	1·77	1·25
55 to 60	6,647	4,167	2,480	142	93	49	2·14	2·23	1·98
60 to 65	4,613	2,721	1,892	130	84	46	2·82	3·09	2·43
65 to 70	2,601	1,533	1,068	101	59	42	3·88	3·85	3·93
70 to 75	1,602	927	675	96	60	36	5·99	6·47	5·33
75 to 80	839	493	346	84	50	34	10·01	10·14	9·83
80 and upwards	365	190	175	59	30	29	16·16	15·79	16·57
Unspecified	1,815	1,378	437	71	54	17	..	..	..

	Mean Population during 1881.			*Deaths during* 1881.					
				Actual No. of Deaths.			No. of Deaths per 100 living.		
Ages.	Persons.	Males.	Females.	Persons.	Males.	Females.	Persons.	Males.	Females.
All ages.	493,069.	271,124.	221,945.	5,491	3,247	2,244	1·114	1·198	1·011
Under 1	18,070	9,261	8,809	1,731	987	744	9·58	10·66	8·45
1 to 2	14,984	7,526	7,458	391	204	187	2·61	2·71	2·51
2 to 3	16,964	8,573	8,391	125	60	65	·74	·70	·77
3 to 4	16,655	8,327	8,328	106	49	57	·64	·59	·68
4 to 5	16,149	8,184	7,965	87	49	38	·54	·60	·48
5 to 10	68,354	34,498	33,856	230	132	98	·34	·38	·29
10 to 15	57,995	29,037	28,958	161	83	78	·28	·29	·27
15 to 20	42,885	21,178	21,707	159	77	82	·37	·36	·38
20 to 25	41,631	22,202	19,429	199	119	80	·48	·54	·41
25 to 30	40,843	24,051	16,792	234	131	103	·57	·55	·61
30 to 35	34,814	20,316	14,498	235	133	102	·68	·66	·70
35 to 40	33,774	20,432	13,342	276	167	109	·82	·82	·82
40 to 45	31,294	20,212	11,082	311	218	93	·99	1·08	·84
45 to 50	21,474	14,051	7,423	269	193	76	1·25	1·37	1·02
50 to 55	14,654	9,607	5,047	219	148	71	1·49	1·54	1·41
55 to 60	7,868	4,882	2,986	172	132	40	2·19	2·70	1·34
60 to 65	6,379	3,830	2,549	167	117	50	2·62	3·06	1·96
65 to 70	3,254	1,890	1,364	129	81	48	3·96	4·29	3·52
70 to 75	2,100	1,182	918	107	67	40	5·10	5·67	4·36
75 to 80	999	585	414	87	45	42	8·71	7·69	10·14
80 and upwards	588	324	264	85	46	39	14·46	14·20	14·77
Unspecified	1,341	976	365	11	9	2	..	..	..

AGGREGATE RESULTS FOR THE THREE CENSUS YEARS 1874, 1878, 1881.

	Aggregate Mean Populations.			*Aggregate Deaths.*			*Mean Death-rate per 100 Living.*		
AGES.	PERSONS.	MALES.	FEMALES.	PERSONS.	MALES.	FEMALES.	PERSONS.	MALES.	FEMALES.
All Ages.	1,228,856.	685,138.	543,718.	14,297.	8,332.	5,965.	1·1634.	1·2161.	1·0971.
Under 1	46,450	23,751	22,699	4,625	2,560	2,065	9·957	10·779	9·096
1 to 2	38,035	19,092	18,943	1,048	531	517	2·755	2·781	2·729
2 to 3	42,812	21,798	21,014	376	192	184	·878	·881	·876
3 to 4	41,303	20,615	20,688	285	137	148	·690	·665	·715
4 to 5	39,609	19,946	19,663	210	110	100	·530	·552	·509
5 to 10	174,417	87,665	86,752	678	360	318	·389	·411	·367
10 to 15	134,685	67,816	66,869	347	177	170	·258	·261	·254
15 to 20	99,489	49,361	50,128	351	179	172	·353	·363	·343
20 to 25	100,722	54,414	46,308	490	270	220	·487	·496	·475
25 to 30	103,139	60,452	42,687	617	344	273	·598	·569	·640
30 to 35	99,353	60,612	38,741	641	364	277	·645	·600	·715
35 to 40	93,089	59,598	33,491	813	519	294	·873	·871	·878
40 to 45	77,628	51,549	26,079	766	546	220	·987	1·059	·844
45 to 50	50,061	33,214	16,847	678	494	184	1·354	1·487	1·092
50 to 55	34,228	22,311	11,917	531	368	163	1·551	1·649	1·368
55 to 60	19,350	12,027	7,323	411	294	117	2·124	2·444	1·598
60 to 65	14,506	8,647	5,859	364	245	119	2·509	2·833	2·031
65 to 70	7,707	4,549	3,158	305	190	115	3·960	4·180	3·643
70 to 75	4,996	2,894	2,102	275	166	109	5·504	5·736	5·166
75 to 80	2,312	1,344	968	208	115	93	9·000	8.557	9·607
80 and upwards	1,180	629	551	183	97	86	15·522	15·446	15·608
Unspecified	3,785	2,854	931	95	74	21	..	..	..

This shows mortality is not simply a result of climate, but is due to many other causes. Some of these agencies will soon be powerless, whilst others will long exist. To their consideration it is necessary to devote some time, otherwise any person examining these tables will be led into many errors. It is not right to say, as some have said, that our low mortality is due to climate solely, or to abundance of cheap food alone. The mortality of any country is a result of many interacting forces.

Amongst the causes leading to a low death-rate in this colony are the following :—

(1.) *Easiness of Struggle for Existence.*

To the sparse population of these lands, with their fertile soils and immense mineral wealth, the struggle for existence is an exceedingly easy one. Here all who work and practice some self-denial are able, at little cost to themselves, to obtain all the necessaries and many of the luxuries of life. All the young get good food and abundance of milk, so that from childhood to old age there is none of that *under*-feeding, which, when prolonged for years, as among the poor in other countries, causes a lowered vitality and an enfeebled offspring. Since all classes find large rewards for little labour, adults striving to live undergo few of the worries and hardships and ceaseless anxieties which fall to the lot of the toiling masses throughout Europe. Here we see the incessant struggle to keep "the wolf from the door" replaced by the sufficiency for a "rainy day."

Few of the farming, trading, or professional classes undergo much mental worry, and therefore do not break down from disappointment or over-anxiety. Moreover, the moderate toil and by no means hurtful self-denial and the general speedy getting of riches beget a continuous cheerfulness, by enabling large numbers to obtain luxuries for their sick and suffering—such luxuries as a change of air, some weeks' holiday, the long rest so often prescribed by the doctor—and, except in these lands, too seldom obtainable. It also enables others who have chosen an unsuitable or unhealthy mode of life easily and fearlessly to change it.

(2.) *Artificial Selection.*

During several years many thousand people were specially picked in Great Britain for importation to this colony. None over the age of forty-five were taken. Only children and young and middle-aged adults were picked. All the emigrants underwent a certain amount of medical inspection, and though some unsatisfactory people were brought out, yet many were rejected, and the immigrants as a whole were a well-chosen healthy lot of people. Certainly they were healthier far than any like number of free immigrants.

Under a system of free immigration the people are specially chosen; and under a system of assisted emigration a like selection obtains, for colonists as a rule send home money for the purpose of bringing out those of their friends who are strong enough and healthy enough "to rough it," whilst they anxiously dissuade those of their friends who, being in ill health, might be unable to provide for themselves and be a burden to colonists. As a rule, too, the people who migrate are those who are strong and healthy, who feel that they are able and willing to rough it. Early colonists are a specially picked lot, for only the strongest and healthiest, only those with the toughest constitutions and the most venturesome dispositions would leave Home comforts for colonial hardships. Delicate men and sickly women generally would eschew all risk of discomfort and remain in their comfortable homes.

As against this selection there must be recognized the fact that year by year this colony is growing in favour as a health resort and that hence there is a selection *against* the colony, in the shape of consumptive, rheumatic and other invalids flocking hither in search of health. This *unfavourable* selection is undoubtedly an important factor directly as it affects the parents themselves and more remotely as they transmit some or all of their maladies to their children.

(3.) *Large Proportion of adult Males.*

The large proportion of adult males in the colony will favourably affect the death-rate, as does also the small proportion of aged persons.

(4.) *Abundance of good Clothing.*

The general prosperity allows even the poorest to be warmly clad, and hence all are protected from the effects of cold and heat and damp. The ragged tattered coats and trousers, the much-torn threadbare garments which cover the poor people in Europe, are here not seen. The children of our poorest have clothes which are at least warm and continuous, not merely loosely connected rags with large interspaces. Our poorest can all obtain stout boots and warm socks and woollen garments for their children —a striking contrast to the almost-naked plight of thousands of poor little frozen children in Great Britain. This widespread distribution of warm clothing saves the lives of numbers of children.

(5.) *Abundance of wholesome Food.*

The cheapness of breadstuffs and potatoes and the low price of meat, combined with general prosperity, give to all abundance of good wholesome food. The low cost of the production of the raw material offers scant inducement for adulteration. Good milk is cheaply bought in the largest towns. This constant supply of sound wholesome food maintains a healthy condition of body, which wards off most of the diseases arising from defective or mal-nutrition.

Experts in social science aver that the death-rate of large classes in Europe is attributable to their being habitually underfed. The enormously high death-rate of those earning the lowest wages (such as workers in silk earning only 2s. 7½d. a week; kid glovers, 2s. 2d.; stocking weavers, 2s. 6½d.; needlewomen, 2s. 7d.), proves that long-continued semi-starvation is an important factor in increasing the death-rate. In France among the rich 68 per 1,000 of all deaths were due to tubercular diseases, but amongst the poor and underfed the rate rose to 230 in 1,000.

(6.) *Large Proportion engaged in Agriculture.*

This means that an unusually large portion of our people lead healthy out-door lives, breathe fresh clear air, live all their days in the freely-blowing breezes and bask in the strength-giving sunshine. We have no huge cities with dense overcrowding; our largest towns have a population living comparatively far apart. We have no dark dens, no life-destroying alleys; our streets are wide.

(7.) *Sparsity of Population.*

The scattered condition of the people, noticeable not only among the agriculturalists but also in the towns. The absence of that constant overcrowding so fatal among older civilizations, which leads to the chronic ill-health of the poor in large European cities and to the rapid spread of all infectious and contagious diseases and conduces so powerfully to that chief scourge of our race, viz., phthisis. Children in our towns look nearly as healthy as those in the country.

(8.) *Paucity of Manufactures.*

With the increase of "local industries" there must inevitably be an increase in the death-rate. Not to quote such vivid cases as phosphorus poisoning and necrosis among matchmakers; or Sheffield grinders' phthisis; or arsenical or copper poisoning; or woolsorters' disease; or brassfounders' ague; or, flintcutters' or needleworkers' or filemakers' chest disease, and a host besides, the rise of manufactures must cause many deaths. Contrast the pallid wan faces, the bowed heads, the feeble sickly look of the crowds of factory hands in Great Britain, with the healthy look of our town dwellers. Or come nearer home, to Melbourne, and no one can question the depressing effect of manufactures on the people. Apart too from this widespread deterioration of the race there is always a certain percentage of deaths due to factory accidents. The absence of manufactures shows itself in a lessened death-rate.

(9.) *Small Amount of Mining.*

As mining developes, so will chest diseases multiply. Coalminers in England suffer terribly from bronchitis, phthisis, pneumonia, and other

chest affections. Cement-workers suffer much, and so do all engaged in the making of pottery. With the multiplication of mines will come multiplicity of accidents and deadly disasters.

(10.) *Our great Distance from the busy Haunts of Men.*

Separated as we are by thousands of miles of ocean and fresh breezes we are necessarily in less danger of catching our neighbours' diseases.

(11.) *Soil.*

Apart from the foregoing causes of a lessened death-rate must be noted the effect of soil and climate. These "Summer Isles of Eden lying in dark purple seas" possess almost everywhere the most perfect natural drainage. The swamps are few, and are fast disappearing. They seem almost harmless. Among the white people malarious fevers are not caught, though many dwell on the edge of these swamps. Men work in them and never get ague as in the fens at Home or in the Maremma in Western Italy, or jungle fever as in Asia and Africa. Colonists work and live among swamps and in forests, and get no evils except rheumatic and chest complaints. They dig in swamps, but the black upturned humus, though composed of decaying and decayed vegetable matter, brings them no harm. "No flat malarian world of reed and rush" troubles the colonist. Neither does the soil contain other evils for man. The water flowing through swamps leaves it full perhaps of decaying organic matter, but free from germs or parasites hurtful to man. The soil and vegetation contain no parasites peculiar to New Zealand, nothing like Bilharzia hæmatobia or Guinea worm. As the black population had invaded these isles only a few centuries and was always sparse and had few diseases, the soil was scarcely, if at all, polluted, and consequently we—the white people—when we dig or plough, upturn a virgin soil, and not, as in many countries, a soil full of deadly organisms.

(12.) *Climate.*

The climate of these islands, lying in the temperate zone, presents few features of note. Stretching as they do through many a league of latitude, lying in the path of the antitrades, with a lofty backbone of mountains running through each island, the climate is exceedingly equable in each district, though that of the districts varies greatly. The changes of climate in each have been carefully noted for many years past, and these records are embalmed in the pages of these volumes. For our purpose the chief points worthy of note are the equability of the various districts,—*e.g.*, the continuous dryness and heat of Hawke's Bay and the raininess of Westland, and the cold of Southland. There are no dangerous siroccos or typhoons, or pamperos: no pestilential deadly breezes. The winds flowing from the uninhabited antarctic regions, or from the equator, waft to us no diseases. The continuous heat of the hottest districts is cold when compared with

torrid climates, and the cold of the south is not extreme. The constant winds blow away all accumulating odours, and keep the atmosphere ever pure.

Phthisical invalids from Great Britain on arrival here always improve. They lose their coughs, grow stronger, and in very many cases recover. Immigrants acquire no new disease due to climate. Those coming from the tropics always gain new life and vigour. Our statistics prove, apart from disturbing causes, that the climate is excellent and conduces to a general lengthening of life. Whether it really conduces to very old age, and is really invigorating to those born in it, are still open questions. The important question what diseases most prevail must be left to a future monograph.

Summary.

Mr. Frankland's statistics show that New Zealand possesses the lowest death-rate of any country in the world; and that the conditions favourable to life are common to all ages. We have seen that New Zealand possesses only a moderate number of the known diseases, that many of the most deadly are always absent, and that there are no new ones. To the enquiry, "Is New Zealand a healthy country?" we have brought ample proof to show that it is as yet the healthiest on the face of the globe. As the country becomes more populous, the death-rate will increase, unless the people make earnest and continuous efforts to lower it. Even the present death-rate might be greatly lessened, by a little care and a little cost, if we saved lives by preventing the spread of typhoid, measles, scarlet fever, and phthisis.

NEW ZEALAND INSTITUTE

NEW ZEALAND INSTITUTE.

Fourteenth Annual Report.

The Board held meetings on the 28th July, and 11th November, 1881.

The retiring members, in conformity with the Act, were Messrs. W. T. L. Travers, T. Mason, and the Hon. G. R. Johnson, all of whom were re-appointed by His Excellency the Governor.

The elected members under clause 7 of the Act are: Mr. Justice Gillies, the Hon. Wm. Rolleston and Mr. James McKerrow.

There are now five vacancies on the roll of honorary members.

The members on the roll of the Institute now number:—

Honorary members	25
Ordinary members—	
Auckland Institute	301
Hawke's Bay Philosophical Institute...	107
Wellington Philosophical Society	277
Westland Institute	100
Philosophical Institute of Canterbury	197
Otago Institute...	213
Southland Institute	65
	1,285

The Nelson Association having withdrawn from incorporation, the number is nominally less than that for last year by fifty members.

The printing of Volume XIV. was commenced in February and completed early in April, a portion of the edition being ready for issue towards the end of May. The volume contains seventy-eight articles, also Presidents' Addresses and abstracts of papers, which appear in the Proceedings and Appendix. There are 610 pages of letter-press and 39 plates.

The following is a division of the contents of the volume for comparison with last year's work:—

	1882. Pages.	1881. Pages.
Miscellaneous	200	170
Zoology	144	79
Botany	104	147
Chemistry	16	4
Geology	52	21
Proceedings...	54	42
Appendix	40	40
	610	503

The volumes of the Transactions now on hand are—Vol. I., 410; vol. II., none; vol. III., none; vol. IV., none; vol. V., 50; vol. VI., 50; vol. VII., 150; vol. VIII., 20; vol. IX., 160; vol. X., 10; vol. XI., 70; vol. XII., 70; vol. XIII., 70; vol. XIV., not yet fully distributed.

From the Hon. Treasurer's balance-sheet it will be seen that there is a balance of £5 11s. 10d. to the credit of the Board, against which there is the balance due to the publishers of £12 13s. 2d.; on the other hand there is a considerable balance from the sale of volumes in the hands of the London Agents.

The Annual Reports of the various departments connected with the Institute are appended.

James Hector,
Manager.

Approved by the Board, 8th August, 1882:
G. Randall Johnson,
Chairman.

Accounts of the New Zealand Institute, 1881-82.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
Balance in hand, 28th July, 1881	49	2	1	Printing Vol. XIV.	582	2	0
Vote for 1881-82	500	0	0	Purchase of second-hand Vols. of Transactions of New Zealand Institute, 5 vols., &c...	2	5	0
Contributions from Wellington Philosophical Society (one-sixth of annual revenue) ..	20	19	10	Miscellaneous	0	2	1
Sale of volumes	19	19	0	Balance in hand	5	11	10
	£590	0	11		£590	0	11

Arthur Stock,
Hon. Treasurer.

8th August, 1882.

Museum.

The number of names entered in the Visitors' Book during the year is 19,000 (week-days, 10,000; Sundays, 9,000) but, as mentioned in previous reports, this gives no adequate idea of the number of persons visiting the institution, as comparatively few care to sign the register. The usual average daily attendance is about fifty on week-days, and 150 on Sundays.

Natural History Collections.

The additions to this section have been somewhat extensive; but the excessively crowded state of the Museum Department renders the exhibition of recent acquisitions quite impossible, until further accommodation is provided.

Mammalia.—Amongst the animals recently added to the collection, and specially worthy of notice are: (1) two skins of the Tasmanian devil (*Diabolus ursinus*), presented by Mr. J. B. Poynter, of Poverty Bay; per Hon. G. Randall Johnson, M.L.C., two hedgehogs (*Erinaceus europaeus*), one sable (*Marter sibellina*), one ermine (*Mustela*), one beautiful specimen of the platypus (*Platypus anatinus*).

Pisces.—The most noticeable addition to this department is a collection of 161 specimens, illustrative of the Ichthyology of the Pacific Coast of North America, presented by the United States National Museum.

Aves.—The acquisitions in this section, though not very numerous, are nevertheless of a very interesting character. The chief items are: (1) several specimens of *Rallus affinis* and allied species from Mr. A. Hamilton, of Napier; (2) an Australian roller (*Eurystomus australis*) shot at Akamotu and presented by Mr. A. Reid; (3) a fine peacock presented by Mrs. Borlase; (4) a pure albino peacock, by Mr. Harding of Napier; (5) a magnificent specimen of the bird of paradise (*Paradisea raggiana*), by Dr. Bennet of Sydney; (6) two bustards (*Otis tarda*) by Mr. Banbury of London; (7) twenty-six skins, New Zealand and foreign, purchased by the Director.

New Zealand birds have been presented to Dr. Finsch, of Bremen; Mr. Hague, of London; and Dr. Buller, Wellington. A collection of thirty-two eggs was sent to Mr. A. Gillies, of Dunedin, as an exchange.

Reptilia.—Only a few New Zealand species have been added to this branch, but a collection of the forms indigenous to this colony has been sent to the Bremen Museum.

Invertebrata.—A collection of coloured corals, presented by Mr. H. E. Liardet, and a very fine collection of New Zealand sponges, presented by Mr. J. A. Smith of Napier, are the chief items under this heading. The sponges, however, are very important, as the quality leaves but little doubt that New Zealand may yet be able to produce sponges suitable for the market.

Ethnological.

Very large collections have been received under this head. Amongst the articles more especially worthy of notice are—(1) two Japanese shrines, 500 years old, from the Temple of Kamakura, presented by Mr. H. S. Tiffen, of Napier; (2) a large collection of weapons, domestic utensils, etc., illustrative of the ethnology of New Guinea and neighbouring islands, received in exchange from Mr. H. H. Romilly, Deputy Commissioner of the Pacific; (3) casts of Maori implements, in exchange from the Canterbury Museum; (4) a cast of the celebrated Rorotangi, the figure of a bird carved

in serpentine, reported to have been brought by the Maoris to New Zealand from Hawaiki, presented by Major Wilson; (5) two Maori carved walking-sticks, purchased; (6) twenty samples of pottery from South Sea Islands, presented by His Excellency Sir Arthur Gordon; (7) Hindoo holy writings, deposited by Miss Woodward.

Miscellaneous.

Amongst the miscellaneous articles lately received are—(1) silver seal of the Colony of New Zealand, defaced by Her Majesty in Council, presented by the Hon. the Colonial Secretary; (2) seal of the Province of Wellington, presented by the Government Storekeeper; (3) collection of timbers, economic vegetable substances, and casts of twelve famous nuggets, etc., in exchange from the Technological Museum, Melbourne; (4) specimens of quartz from Te Aroha, presented by the Hon. the Minister for Mines and Mr. J. C. Firth; (5) eight glass show-cases used at the Crystal Palace Wool Show, presented by the Hon. the Colonial Secretary; (6) map of Wellington in 1841, deposited by the Hon. W. B. D. Mantell; (7) iron pipe made by Mr. P. Birley, of Auckland, deposited by Mr. W. Swanson, M.H.R.; (8) one gold, two silver, and two bronze medals awarded to the colony at the Crystal Palace Wool Exhibition, presented by the Hon. the Colonial Secretary; (9) portrait in oils, known as the "Molesworth Portrait," deposited by Sir W. Fitzherbert.

Geological Survey.

During the past year Mr. Cox has been engaged for three months, from January to March, in an examination of Cape Colville Peninsula, more especially at the mining centres of the Thames, Coromandel, Waitekauri, Owharoa, Waihi, and Te Aroha. The most important results which he has obtained, lie in his determination of the stratification of the rocks at the Thames. He has shown there that the beds of the auriferous series consist of alternations of a moderately hard, compact, pyritous, tufaceous sandstone (tufanite of Dr. Hector); with less pyritous beds; a similar rock, which is, however, much broken up into pieces by joints; and a hard green dioritic rock, which is of true fragmental origin, but which passes at places into crystalline bands which are never continuous for any great distance. It is in the first of these that the reef has proved most highly auriferous, and while gold does occur in them while passing through the second class of country, they are not as a rule payable, and where the reefs traverse the hard rocks, they are absolutely barren. He has shown that several of these hard belts occur, and that where they are met with in the lower levels of the mines, the gold is cut off by them, but that other belts of auriferous country occur below, in which reefs have been worked. His work generally tends to show that, so far from the Thames being worked out,

there are yet, in all probability, as rich auriferous belts of country at lower levels as have hitherto been worked near the surface, and that gold will be found to quite as great depths as it is practicable to work. Besides this, he has illustrated the structure and behaviour of the reefs by numerous sections, and has also prepared a plan and section of the Ohinemuri and Te Aroha Districts.

During part of April he was engaged in an examination of the Blue Mountains, on the northern side of the Shag Valley, with the special object of determining the position of the Blue Mountain limestones. These he has shown are interstratified with slate and sandstone of Lower Carboniferous age, which form the first range north of the Shag River, and are separated from the Te Anau series of Upper Devonian age, which form the next range by a large fault which traverses the country in a N. 65° W. magnetic direction, and has a downthrow to the S.E.

Mr. Cox has also made special reports on the Woodstock Gold Field and the Ross and Humphrey's Gully mining claims on the West Coast, and has examined the lignite deposits at Norsewood, which he reports to be of an inferior character.

During the latter part of November, and part of December, Mr. McKay was engaged in collecting moa bones at Motanau and examining the country between Motanau and the Cheviot Hills. During this work the principal result arrived at, from an economic point of view, was the discovery of an outcrop of hematite about six feet wide, associated with the Triassic rocks of the coast range near Motanau. An analysis shows that this ore is specially adapted for the manufacture of hematite paint. After this he was engaged in Museum work during the month of January, and during February and the early part of March he examined the antimony deposits of the Carrick Ranges in Otago and collected fossils from the coal strata of the Bannockburn. He reports that there are three lodes which are apparently convergent, the thickest of these being two feet at its widest part; an outcrop of antimony can be traced at places on the surface from Alexandra, at the Manuherikia Junction, to the hills west of the Nevis Bluff, on Kawarau River, a distance of over twelve miles. During April and May he was engaged, at the request of the Hon. the Minister of Mines, in making a typical collection of the rocks of the Reefton District in duplicate. One of these collections was deposited at Reefton as the nucleus of a museum. While thus engaged he made a detailed examination of the relations of the various beds and confirmed the views previously held concerning them. He also gained important information concerning the extent of the coal-bearing areas, proving their probable continuance, as a basin, across the Inangahua Valley, comparatively near the surface about Reefton, but at much deeper

levels towards the junction of the Inangahua and Buller Rivers. He also made a special report on an antimony lode at Reefton, showing that an outcrop had been found which was about eighteen inches thick, and the reef had been driven on for 150 feet from that point without antimony being found. Heavy lodes of antimony are, however, found in several of the auriferous claims from Rainy Creek to Boatman's, which, in all cases containing gold, are treated in the ordinary way for the extraction of this alone, all the antimony and probably much of the gold being thus sluiced away. An examination of the auriferous cements at the head of Lankey's Gully showed that tinstone undoubtedly occurred associated with these in small quantities, but bad weather prevented any attempt being made to trace this back to its parent rock. He visited Langdon's Reef, near Greymouth, and reports that the thickness of the reef, at present being worked, is about two feet nine inches, which, being less than it was at the outcrop, shows the lode to be of a bunchy character.

The outcrops of coal in Coal Creek, Greymouth, were also examined, and he reports that two seams of coal 6 feet and 10 feet in thickness respectively, occur in the lease, in which a considerable quantity can be worked level free. In the month of June Mr. McKay paid a visit to the Terawhiti reefs, and reports that the Albion claim possesses a reef of an average thickness of from 18 inches to 2 feet, which has been followed along its strike for a distance of 6 chains, and for a depth of 130 feet. Some assays of quartz from this claim have yielded over 3 ozs. of gold per ton, but the specimen brought by Mr. McKay gave nothing but traces of the precious metal.

Publications.

The following publications have been issued during the year: (1.) Sixteenth Annual Report of the Colonial Museum and Laboratory, together with List of Additions, etc., and an Abstract of the Results of Analyses. 64 pp. 8vo. (2.) Manual of the Birds of New Zealand, illustrated with 39 lithographs and 22 woodcuts. 106 pp. 8vo. The Fifteenth Progress Report of the Geological Survey of New Zealand for 1880–81. By Dr. Hector. With maps and sections. Including Special Reports on the Chrome Deposits of New Zealand (Hector, Cox); on the Aniseed Valley Copper Mine (Cox); on the Richmond Hill Silver Mine (Cox); on the Wallsend Colliery, Collingwood (Cox); on the North Auckland District, including Thames and Coromandel Gold Fields, Island of Kawau, and Drury Coal Field (Cox); on the Aorere and Takaka Districts, Nelson (Cox); on the Waitaki Valley, Lindis, and Wanaka Lake District (McKay); on the Coal-bearing Deposits near Shakspeare Bay, Picton (McKay); on the Caswell Sound Marble (McKay). An Index to the Localities where Fossils

have been collected in New Zealand, with their Stratigraphical Position, is in course of publication, and will shortly be followed by the Sixteenth Progress Report.

The Handbook of New Zealand, prepared by Dr. Hector for the Melbourne Exhibition, is now out of print, and a third edition is in preparation.

Progress is being made with the preparation of several important works bearing on the Natural History, Mineralogy and Geology of the colony.

Libraries.

The libraries in connection with the Museum have increased rapidly during the past year, and it was thought necessary that a librarian should be appointed. Mr. T. W. Kirk has been placed in charge of the Patent and Public Libraries, the work being performed out of official hours.

New Zealand Institute Library.—The additions to this library comprise about 255 volumes received in exchange for the Transactions from the various societies and institutions whose names appear in List III.

Patent Library.—This collection remains as hitherto in the lecture-room, and appears to be greatly appreciated, especially by those engaged in mechanical pursuits. Thirty-two volumes have been added during the year.

Public Library.—It was stated in last report that very many of the works belonging to this library were missing when it was removed to the Museum. Private inquiry by the librarian resulted in the recovery of sixteen volumes, and it has now been decided to advertize in the local newspapers and the Government *Gazette* requesting persons having in their possession books belonging to this Library, to return the same to the Museum as soon as possible; it is hoped that by this means a large proportion of the missing works may be recovered.

Meteorology.

Meteorological statistics are collected at four second-class stations in New Zealand, at Auckland, Wellington, Christchurch, and Dunedin; and observations of rainfall, temperature and wind-direction are received from thirty third-class stations. The results are published monthly, and will be collected as usual into a biennial report. There is no first-class meteorological station in New Zealand having the equipment required by the Intercolonial Conference.

The system of intercolonial telegraphic weather exchange has now been in operation for twelve months, and the results obtained and the proposals for securing earlier publication, in an easily comprehensible form, of the weather changes, will form the subject of a special report.

The New Zealand weather for each day is now published the same afternoon in Sydney, Melbourne and Adelaide; and there is no reason why, with a few changes in the organization of the system, the Australian weather phase for each day should not be published in all the principal towns in New Zealand on the following morning. By this means from twenty-four to sixty hours' notice would be given of all the most important weather changes.

Observatory.

The time-ball service for Wellington is at present suspended, as the ball was dismounted when the old Custom House was removed. Arrangements are being made, however, for its re-erection in a prominent position. In the meantime the Telegraph Department continues to be supplied with mean time, and time signals are furnished to Lyttelton and to various private persons by galvanometers.

In reply to an application from the Home Government, arrangements are being made for organizing a corps of local observers for the forthcoming Transit of Venus in December, to assist the party of observers that are to be sent out from Greenwich Observatory.

Laboratory.

The number of analyses performed in the Colonial Laboratory for ordinary purposes during the past year is 265, and the Laboratory number now arrived at is 3,285.

These analyses are subdivided as follows:—Coals, 13; minerals and rocks, 58; metals and ores, 40; examinations for silver and gold, 89; waters, 21; miscellaneous, 40. Total 265.

Besides the above, a large number of examinations have been made under the Adulteration Act of 1880, by the Analyst; and about the month of August time was occupied in visiting the Rotorua District, at which place he collected samples and analyzed specimens of water from the various springs. The Analyst has also been occupied at various times in verifying certain sets of weights and measures, in compliance with the Act.

The results of the analyses, which are of general interest, are noted in full in the Annual Report on the Museum and Laboratory.

James Hector.

PROCEEDINGS

WELLINGTON PHILOSOPHICAL SOCIETY.

First Meeting. 26*th April*, 1882.

Dr. Hector in the chair.

New Members.—Rev. H. V. White, Rev. A. Dasent, Dr. Dakers, Dr. Cole, Emil Senn, F. V. Waters, J. P. McAlister.

1. "Does Morality depend on Free Will?" by the Rev. H. Vere White, M.A.

2. "Notes on the Katipo, a Venomous Spider of New Zealand," by C. H. Robson, lighthouse-keeper on Portland Island.

Mr. Robson was of opinion that there is a variety on the island with only faint red markings on the abdomen, having all the habits of the known variety.

No full description or specimen was forwarded, and Dr. Hector thought it would be premature, under the circumstances, to take it for granted that there are two distinct species.

3. "On the Search for concealed Coal in New Zealand," by J. C. Crawford.

ABSTRACT.

The writer suggested that search should be made with the diamond drill for concealed coal measures, which were overlaid by tertiary formations, in the valleys of the Wanganui, Wangaehu, Turakina, and Rangitikei rivers, at spots which the Geological Department might point out; also that the eastern side of the dividing range might also be examined, though the borings at Poverty Bay should give an indication of the strata.

Dr. Hector did not think that the suggestion was of much use without indications of the best localities, as it would not be a very wise proceeding to bore at random where there was perhaps 2,000 or 3,000 feet to bore through.

Mr. J. C. Harris suggested that Mr. Crawford might have thrown out the idea for the benefit of future generations. The surface deposits on the West Coast and in Auckland were known to be so extensive that the colony would be amply supplied from them for at least five or six hundred years. These must be nearly exhausted before any boring operations for concealed deposits could be undertaken with profit.

Second Meeting. 8*th July*, 1882.

W. T. L. Travers, F.L.S., President, in the chair.

New Members.—A. S. Atkinson, J. B. Byrne, J. L. D'Arcy Irvine, C.E., H. B. Kirk, B.A.

1. The President apologized for not being able on this occasion to deliver the usual opening address, owing to pressure of professional business. He trusted, however, at subsequent meeting to make a few remarks.

2. Several interesting communications from Mr. J. C. Crawford, now in England, accompanied by pamphlets and printed notices bearing on the subjects, were read, the most important being on the "Manufacture of Granolithic Cement," the material for which, he considered, was abundant in New Zealand.

Dr. Hector considered this a question of great importance, and the information was most valuable. We had ample material in accessible positions, and he had no doubt that in time we could ourselves manufacture all the cement and concrete we required in the colony and of the very best kind. He instanced the blocks now largely used here, and known as O'Neill's patent flagging, as showing the excellent quality of this production, which was so highly thought of at the Sydney and Melbourne Exhibitions.

The President endorsed these views, and remarked that he hoped in time also to see the splendid granites we had largely used in constructive works.

Dr. Newman mentioned the newly-erected cement works in Nelson, which would prove of great importance, and entirely supersede the imported article.

3. "On Suitable Hedge Plants for New Zealand," by J. C. Crawford.

4. "On Harvesting Crops independent of Weather," by J. C. Crawford.

5. "On Ensilage," by J. C. Crawford, F.G.S.

6. Archdeacon Stock submitted to the Society a circular sent to him by Mr. Tebbutt, of Windsor Observatory, New South Wales, inviting assistance from New Zealand observers in systematic "comet-seeking."

Dr. Hector explained that Mr. Tebbutt was a most zealous worker in this branch of astronomy, and had been foremost in discovering the southern comets. He had been requested by the Astronomical Society at Boston, who had established a corps of comet-seekers, to endeavour to get information from southern latitudes, and hence this appeal to New Zealand. He (Dr. Hector) knew that there were many amateur observers in possession of good instruments who might do valuable service in this direction. It was a pity that we had not in New Zealand a properly-equipped astronomical observatory placed in a suitable position; and he believed, if the societies combined in an appeal to Government, something might be done in this matter. He would suggest that a copy of this circular be sent to the other societies inviting co-operation in this special matter of comet-seeking, and in an endeavour to bring about the establishment of a permanent observatory.

The President concurred, and said he thought such an appeal would be successful.

7. "On Weather, Health, and Forests in Mauritius," by Dr. Meldrum.

The President pointed out that this bore immediately on the question of forest conservation in New Zealand. He gave a short description of the damage done by the destruction of our forests, which brought about floods of a most disastrous kind.

Dr. Hutchinson, who had recently arrived from the Sandwich Islands, stated that there, in consequence of the wholesale destruction of the forests, floods had occurred doing great injury. The water rushed down the bare hills and through the valleys, and then followed a long drought and the ground became baked, as there was no vegetation left to hold the moisture of the previous rain. He was glad to say that the settlers had at last seen the necessity of forest conservation and great improvement was taking place.

8. Mr. Chapman described a brilliant triple meteor seen by him on Wednesday last. It was travelling from the south.

9. Several recent additions to the Museum were laid on the table for inspection, among them being a case of gold and silver medals awarded to New Zealand at the Wool Exhibition at the Crystal Palace, Sydenham.

THIRD MEETING. *29th July*, 1882.

W. T. L. Travers, F.L.S., President, in the chair.

New Members.—Dr. Hutchinson, Dr. Keyworth.

1. "On the Thames Gold Field and the Laws which govern the Distribution of the Gold," by S. H. Cox, F.G.S. (*See* Geol. Surv. Reports, 1882.)

2. "On the Waterspout which occurred in the Neighbourhood of Cook Straits on the 15th July, 1882," (with illustrations,) by J. W. A. Marchant.

ABSTRACT.

The waterspout was first seen from Lyall Bay, about 1·30 p.m., and continued in sight about a quarter of an hour. A squall, accompanied by heavy rain, was passing from the westward through Cook Straits towards Cape Palliser. It was whilst engaged watching the progress of the storm from the western shore of the bay that I observed the waterspout clear of the south head, bearing about S.E., and distant, perhaps, two miles on the northern verge of the storm area. It presented the appearance of a cylinder of a blue-grey colour, several hundred feet in height, and of uniform diameter. It conveyed the impression that it was suspended from a mass of lowering clouds, the extremity near the surface of the sea being distinctly pointed, like a crayon, resting upon a zone of elevated water in an intense state of agitation, but the gyratory motion was not perceptible in the upper part. The column was slightly curved, being bent over towards the west, and it travelled in the opposite direction towards Fitzroy Bay, and as the movement was quickest at the base the inclination from the perpendicular increased; the clouds seemed to descend and assume the form usual in such cases, that of an inverted cone, whilst the vapours over the sea were drawn upward, when the waterspout appeared to fade away, the last appearance of the column being that of a light grey streak, contrasting remarkably with the gloomy background. No unusual sound accompanied the phenomenon; there were indications that it was not the only one formed, but the mist was too dense to enable this to be clearly ascertained. The storm did not break over Lyall Bay till 3 o'clock, when there was a great downpour of hail and rain, accompanied by lightning and thunder. The points which impressed me most were the immense height, the symmetry, and the distinctness of the column, and the absence of agitation and convolution in the first stage, save at the surface of the sea.

3. At the close of the meeting the Chairman drew attention to a fine collection of potteryware, manufactured by Messrs. Austin and Kirk, of Christchurch, being a portion of their exhibit at the recent exhibition, and which they had presented to the Museum. They comprised vases and flowers, fern-stands, corner pieces for buildings, and a variety of useful articles for domestic use. A collection of glassware from an Auckland firm was also exhibited; the whole of which were greatly admired by those present, and the President said that it was most gratifying to find important industries like these carried on so successfully in so young a colony. He understood that these articles could be obtained at prices quite as low as those imported.

FOURTH MEETING. *26th August*, 1882.

W. T. L. Travers, F.L.S., President, in the chair.

New Members.—W. C. Chatfield, G. S. Evans, J. Walker, T. B. Arnold, B.A.

1. "On Hawaii-nei and the Hawaiians," by Dr. Hutchinson. (*Transactions*, p. 467.)

FIFTH MEETING. *2nd September*, 1882.

W. T. L. Travers, F.L.S., President, in the chair.

1. "On the Decline of the Hawaiian Race and the peculiar Forms of Disease prevalent among them," by Dr. Hutchinson.

SIXTH MEETING. *30th September*, 1882.

W. T. L. Travers, F.L.S., President, in the chair.

New Member.—G. V. Shannon.

SEVENTH MEETING. *21st October*, 1882.

W. T. L. TRAVERS, F.L.S., President, in the chair.

New Member.—T. Turnbull.

1. The society nominated for election an honorary member of the New Zealand Institute.

2. "Remarks upon the Distribution within the New Zealand Zoological Sub-region of the Birds of the Orders *Accipitres*, *Paessres*, *Scansores*, *Columbæ*, *Gallinæ*, *Struthiones*, and *Grallæ*," by W. T. L. Travers. (*Transactions*, p. 178.)

This paper discussed the distribution of certain birds in relation to the question of the former connection of New Zealand with other islands of the Pacific.

Dr. Hector considered this a most important contribution to the statistical branch of natural history and that it would form a valuable supplement to Dr. Buller's recently published manual. He thought that the distribution of birds was very much controlled by the abundance of their favourite food at periods when they were not engrossed in the business of nesting.

3. "Remarks on some Bones lately discovered by Mr. H. T. Wharton in Caves at Highfield, Canterbury," by Dr. Hector.

This was a description of a valuable collection of the bones of *Aptornis* and *Dinornis* found by Mr. Wharton and presented by that gentleman to the Museum. The point of interest was the association of these bones with those of the rat, kiwi, kaka and weka, suggesting that no great period had elapsed since the deposit took place.

The President stated that he had some years ago found bones in the Collingwood district under similar circumstances and had sent them to England, but unfortunately they had been lost.

4. "On a new Mineral belonging to the Serpentine Group," by S. H. Cox, F.C.S., F.G.S. (*Transactions*, p 409.)

5. "On the Non-metallic Minerals of New Zealand," by S. H. Cox. (*Transactions*, p. 361.)

This is a continuation of the paper read and published last year on the metallic minerals by the same author.

6. Dr. Hector exhibited some views of the comet and a diagram of its orbit, and by the aid of a model gave a most lucid and interesting explanation of the phases through which it has passed since the 7th September, when it was first observed. He mentioned, as a

remarkable feature in regard to this comet, that it had approached more closely to the sun than any comet on record, except perhaps that of 1843, and that astronomers were of opinion that it was following very closely the orbit of that comet, if not identical with it.

7. Among the objects exhibited to the meeting were two salt-water fishes, *Dajus forsteri* (green mullet), and *Retropinna osmeroides* (New Zealand smelt), taken with the fly in the Hutt River, about three miles from the mouth, by Mr. Howard.

Eighth Meeting. *9th December*, 1882.

W. T. L. Travers, F.L.S., President, in the chair.

New Member.—J. R. Blair.

1. "Additions to the Flora of New Zealand," by J. Buchanan, F.L.S. (*Transactions*, p. 339.)

The three plants described were collected by Mr. H. H. Travers in the Collingwood district.

2. "On Ancient Science," by the Rev. T. Le Menant des Chesnais.

ABSTRACT.

The object of this paper was to show the origin and progress of science from the earliest times. Science was largely cultivated, and civilization much advanced before the flood. Antediluvian men were acquainted with agriculture, astronomy, mineralogy, and poetry. Chaldea was the cradle of scientific investigation. Astronomy, mechanics, architecture, and navigation flourished there. The discoveries lately made and so well described by Botta and Layard show how, from the most remote period, Assyrians cultivated science. The Jews cultivated natural science, poetry, music, agriculture; but their knowledge of exact science was limited. Greece was always a scientific nation. The ancient Greek philosophers treated admirably many questions on the nature of man and animals, and explained accurately several important phenomena. Sculpture, painting, music, architecture, astronomy, etc., were at all times highly esteemed by the Greeks. Among the men who most contributed to scientific progress at Greece, we must not forget Aristotle and the great men of the school of Alexandria. The Romans adopted the ways and manners of the nations they had conquered. They encouraged foreign arts and scientific men, but produced none. Even the works of Pliny cannot be styled truly scientific; they are a compilation without order or taste, an imperfect encyclopædia.

The President complimented the author on the manner in which he had dealt with the subject, which he felt sure was highly interesting to those present.

After the paper was read M. des Chesnais exhibited a beautiful series of photographs illustrative of the subjects on which he had treated.

3. "Description of a new Species of *Æolis*," by T. W. Kirk. (*Transactions*, p. 217.)

4. "Description of a new Dipterous Insect," by G. Vernon Hudson; communicated by T. W. Kirk. (*Transactions*, p. 218.)

Ninth Meeting. *3rd February*, 1883.

W. T. L. Travers, F.L.S., President, in the chair.

New Member.—W. A. Gardner.

1. The President stated that Mr. Martin Chapman, who had been chosen by the Society to vote in the election of Governors of the New Zealand Institute for this year, had been duly elected, with the Hon. Mr. Rolleston and Mr. J. M'Kerrow.

2. "Remarks upon Mr. Travers' Paper on Sandfixing," by J. C. Crawford, F.G.S.

ABSTRACT.

Mr. Crawford took exception to Mr. Travers' proposal for planting the *Pinus maritima* for this purpose, chiefly on account of the risk of fire; the cost of labour, and the fact that it would not stand the sea breezes. He recommended, as more suitable, *Cupressus macrocarpa* and other hardy pines, and the olive also might thrive.

Dr. Hector thought the Australian wattle would be a suitable tree for such a purpose, and the Government, he stated, had purchased large quantities of the seed for distribution. It was found to be profitable in Victoria, on account of its bark, for tanning purposes, and no doubt it would be so here.

Dr. Hutchinson stated that the *Algarobia* tree had proved useful for the purpose stated in Honolulu.

3. "Is New Zealand a healthy Country?" by Alfred K. Newman, M.B., M.R.C.P.; with Statistics, by F. W. Frankland. (*Transactions*, p. 493.)

Mr. Holland regretted the evils arising from the introduction of manufactures and hoped that some of them might be provided against.

Dr. Hutchinson drew attention to the waste of human life in the colony due to preventible diseases, arising from the culpable neglect of all sanitary precautions. The waste of life from such preventible ills as scarlet and typhoid fevers was scandalous. He thought diseases among women arising from overwork in domestic life was very large.

Dr. Cole maintained that malaria did exist in the colony and that a true ague was not uncommon.

Dr. Hector strongly urged that, in place of dull wearisome figures, authors should exhibit statistical results by means of diagrams. Graphic representations more deeply impressed and were more explanatory. He said that in the gold mining towns of New Zealand, where the population had once been dense and careless of sanitary precautions, the soil had become so polluted that now, years afterwards, the remnants of the population are attacked by epidemics, which are severe and frequent, owing to the accumulation of old filth.

4. Communications by Messrs. Field and Drew were read, giving a description of a fish caught by the natives at Wanganui and thought at first to be the Californian salmon, but which proved to be the brown trout. A photograph of the fish was exhibited.

5. A fine specimen of cork, grown by Mr. Mason of the Hutt, was shown. It was taken from a tree fifteen years old. A drawing of the tree was shown, and Dr. Hector gave some interesting information regarding cork trees in other countries and of the progress of the bark growth; and stated that, from the specimen before them, it was clear that cork of excellent quality could be produced in this country and that the growth would probably be more rapid than elsewhere.

6. Dr. Hector laid on the table copies of the Alpine Journal, which contained papers by the Rev. Mr. Green, with an account of his ascent of Mt. Cook; and at the same time drew attention to some remarks which had appeared in the Press and might lead to the idea that he had doubted the accuracy of Mr. Green's calculations regarding the altitude reached. He had no wish whatever to dispute Mr. Green's statements.

ANNUAL MEETING. *28th February*, 1883.

Dr. Newman in the Chair.

New Members.—Joseph Mackay, M.A., L. S. Reid.

ABSTRACT OF REPORT FOR 1882.

There have been nine general meetings of the Society held during the year, at which twenty-seven papers have been read on the following subjects:—Geology, 5; Zoology, 5; Botany, 5; Miscellaneous, 12. Twenty-two additional members have been elected during the year, and six names taken off the roll, leaving a total of 319 now on the books. Thirty-seven volumes have been added to the library besides the usual pamphlets and periodicals. Mr. Martin Chapman, the member nominated by the society to vote in the election of governors of the New Zealand Institute, was duly elected. The statement of accounts shows the balance at present to the credit of the society to be £105 11s. 7d. while among the items of expenditure are £53 2s. 1d. for books, and £28 17s. 6d. paid to the New Zealand Institute in accordance with the Act.

The report and balance sheet were adopted.

ELECTION OF OFFICERS FOR 1883:—*President*—The Hon. G. R. Johnson, M.L.C.; *Vice-Presidents*—Dr. Buller, C.M.G., F.R.S., A. K. Newman, M.B., M.R.C.P.; *Council*—R. Govett, M. Chapman, James Hector, M.D., C.M.G., F.R.S., S. H. Cox, F.G.S., F.C.S., T. King, W. T. L. Travers, F.L.S., F. B. Hutchinson, M.R.C.S.; *Secretary and Treasurer*—R. B. Gore; *Auditor*—H. F. Logan.

The Hon. Mr. Johnson, the new President, then took the chair, and the following papers were read.

1. "On the Lichenographia of New Zealand," by Charles Knight, F.R.C.S. (*Transactions*, p. 346.)

2. "Description of a new Species of *Senecio*," by T. Kirk, F.L.S. (*Transactions*, p. 359.)

AUCKLAND INSTITUTE.

First Meeting. *29th May*, 1882.

E. A. Mackechnie, President, in the chair.

New Members.—R. Anderson, J. Banks, R. Browning, C. E. Bourne, F. E. Compton, J. M. Dargaville, N. Giblin, E. W. Hanmer, A. G. Horton, A. E. Isaacs, Dr. Kenderdine, Dr. Kidd, A. H. Nathan, J. M. Shera, C. B. Stone, W. Thorne, H. J. Wickens.

1. The President delivered the anniversary address.

2. "On some recent Additions to the Flora of New Zealand," by T. F. Cheeseman, F.L.S." (*Transactions*, p. 298.)

3. "Additions to the *Geodephaga* of New Zealand," by Captain T. Broun, M.E.S.

Second Meeting. *26th June*, 1882.

E. A. Mackechnie, President, in the chair.

New Members.—C. Cooper, A. Grey, T. Melville.

1. "New Species of *Pselaphidæ*," by Capt. T. Broun, M.E.S.

2. "On the Protective Resemblances of the *Araneidea* in New Zealand," by A. T. Urquhart. (*Transactions*, p. 174.)

3. "Notes on the Origin of Language," by H. G. Seth Smith.

4. Mr. H. G. Seth Smith exhibited a harmonograph for producing harmonic curves.

ABSTRACT.

The construction of the instrument is such that a finely-pointed glass pen, placed at the junction of two cranks proceeding from the top of two pendulums vibrating at right-angles to one another, traces curves on a sheet of paper. Attention was drawn to the endless variety of curves produced by varying the length of one of the pendulums; and it was pointed out that the curves were then only symmetrical when the ratio of the times of vibration corresponded to a definite interval in music, as a third, fifth, octave, etc. In other cases asymmetrical figures were produced.

Third Meeting. *31st July*, 1882.

E. A. Mackechnie, President, in the chair.

New Members.—F. Lawry, J. Street.

1. "New Genera and Species of *Heteromera*," by Capt. T. Broun, M.E.S.

2. On some recent Additions to the Flora of New Zealand," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 298.)

3. "Further Experiments with *Sorghum*," by Mr. Justice Gillies. (*Transactions*, p. 261.)

4. "On the Effects of School-life on the Sight," by B. Schwarzbach, M.D. (*Transactions*, p. 472.)

FOURTH MEETING. 28*th August*, 1882.

E. A. Mackechnie, President, in the chair.

New Members.—J. McLaren, P. E. Cheal, H. W. Northcroft, J. H. Jackson, T. Wells, F. R. Webb, Rev. Mr. Gulliver.

1. "New Genera and Species of *Curculionidæ*," by Capt. T. Broun.

2. "On the Growth of the Cork Oak (*Quercus suber*) in the Auckland District," by Mr. Justice Gillies. (*Transactions*, p. 267.)

3. "The University of New Zealand: its History, Constitution, and Objects," by the Right Rev. W. G. Cowie, D.D.

A long discussion followed the reading of this paper, in which Mr. Justice Gillies, Mr. Halcombe, Mr. Martin, Dr. Purchas, and others took part.

FIFTH MEETING. 25*th September*, 1882.

E. A. Mackechnie, President, in the chair.

New Members.—H. Eastman, W. Fidler, T. Simpson, W. P. Snow.

1. "New Species of *Coleoptera*," by Capt. T. Broun.

2. "On two new Planarians from Auckland Harbour," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 213.)

3. "Shakspeare and Euphuism," by J. Murray Moore, M.D.

ABSTRACT.

This paper was chiefly occupied with a criticism of John Lilly and his works, and their influence upon the literature of the reign of Elizabeth. According to the author, this influence could be traced through many of Shakspeare's plays.

SIXTH MEETING. 23*rd October*, 1882.

E. A. Mackechnie, President, in the chair.

New Members.—Dr. Edgelow, Rev. Mr. Macrae.

1. "On the Occurrence of *Platinum* in Quartz Lodes at the Thames," by J. A. Pond. (*Transactions*, p. 419.)

2. "Note on the Origin of the Boomerang," by W. D. Campbell, F.G.S. (*Transactions*, p. 459.)

3. "New Species of *Coleoptera*," by Capt. T. Broun, M.E.S.

4. "The Visionary Faculty of Mind," by E. A. Mackechnie.

Seventh Meeting. 20*th November*, 1882.

E. A. Mackechnie, President, in the chair.

The President gave particulars of a donation of 127 volumes of books relating to the early history of New Zealand, presented to the library of the Institute by Mr. J. T. Mackelvie, and also drew attention to four most valuable oil-paintings presented to the citizens of Auckland by the same gentleman, and lodged for the present in the care of the Institute.

An unanimous vote of thanks was awarded to Mr. Mackelvie.

1. "The Naturalized Plants of the Auckland Provincial District," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 268.)

2. "Our Earliest Settlers," by R. C. Barstow. (*Transactions*, p. 421.)

3. "Imaginary Quantities," by H. G. Seth Smith.

Annual General Meeting. 19*th February*, 1883.

E. A. Mackechnie, President, in the chair.

The minutes of the last annual meeting were read and confirmed.

ABSTRACT OF ANNUAL REPORT.

Thirty-four new members have been added to the roll since the last annual meeting. The total number on the roll at the present time is 321, showing a nett increase of nineteen during the year.

The balance sheet shows the total revenue from all sources to have been £403 8s. 1d., the members' subscriptions having yielded £317 2s. 0d. The expenditure amounts to £397 8s. 6d., leaving a credit balance of £5 19s. 7d. Among the items of expenditure are £44 1s. 5d. for books, £26 8s. 0d. for Museum fittings, and £32 for taxidermist.

Seven meetings were held during the session, and twenty-three papers on various subjects were read.

Many valuable contributions to the Museum were received, and the donations to the library were unusually extensive and valuable.

Election of Officers for 1883:—*President*—Rt. Rev. W. G. Cowie, D.D.; *Vice-Presidents*—E. A. Mackechnie, T. Peacock, M.H.R.; *Council*—G. Aickin, J. L. Campbell, M.D., W. D. Campbell, F.G.S., Mr. Justice Gillies, Hon. Colonel Haultain, Neil Heath, J. Martin, F.G.S., J. A. Pond, Rev. A. G. Purchas, M.R.C.S.E., H. G. Seth Smith, S. Percy Smith, F.R.G.S.; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S.; *Auditor*—T. Macffarlane.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

First Meeting. *9th February*, 1882.

Professor F. W. Hutton, Vice-President, in the chair.

This meeting was called by the Council for the purpose of submitting to the Institute a revised code of Laws, these were duly considered and an unanimous resolution passed repealing the existing Laws and adopting those submitted.

Second Meeting. *2nd March*, 1882.

R. W. Fereday, Vice-President, in the chair.

New Members.—N. Black, C. J. Mountfort.

1. "Additions to the Molluscan Fauna of New Zealand," by Professor F. W. Hutton. (*Transactions*, p. 131.)

2. "On Earthquake Phenomena," by J. D. Enys.

ABSTRACT.

The author desired to place on record the following facts which occurred after the earthquake of 6th December. The manager of the Grassmere station, about two hours after the shock, or about a quarter to ten, rode past Lake Sarah, situated at the foot of the hill called the Sugar Loaf, about a mile from the Cass Hotel. He was astonished to see, about two to three chains from the shore, two mounds of water being thrown up to about four feet above the surface of the lake; and two hours after on his return past the same place these fountains were still playing. I have known the manager, Mr. H. Carson, for about eighteen years and can fully trust his evidence and think the fact worth recording. I can suggest no explanation of the occurrence, unless it be the escape of gas. I am sorry I have no further account of the length of time which the fountains played.

The earthquake was felt strongly in the Upper Waimakariri Valley and caused considerable damage to stone chimneys both at Craigie Burn and Castle Hill. The hotel at Castle Hill was much damaged; the south-east corner had to be rebuilt, the northern wall was uninjured but the southern one was much shaken. The bottles in the bar, the shelves of which run east and west and face north, were all thrown inwards or to the south.

Third Meeting. *6th April*, 1882.

Professor J. von Haast, President, in the chair.

New Member.—E. Meyrick.

1. "Notes on a Skeleton of *Megaptera lalandii*," by Professor J. von Haast. (*Transactions*, p. 214.)

2. Note on the Silt Deposit at Lyttelton," by Professor F. W. Hutton. (*Transactions*, p. 411.)

3. "Additions to the Isopodan Fauna of New Zealand," by C. Chilton, M.A. (*Transactions*, p. 145.)

Fourth Meeting. *4th May*, 1882.

Professor F. W. Hutton, Vice-President, in the chair.

1. The following motion was passed at this meeting:—"That this Society desires to place on record its high appreciation of the great services that have been rendered to science by the late Dr. Charles Darwin and its deep sense of the loss that science has sustained through his death."

2. "Descriptions of New Zealand *Micro-Lepidoptera*," by E. Meyrick, B.A. (*Transactions*, p. 3.)

3. "Notes on some of the Diatomaceous Deposits of New Zealand," by J. Inglis. (*Transactions*, p. 340.)

Fifth Meeting. *1st June*, 1882.

W. M. Maskell, Honorary Treasurer, in the chair.

"On the New Zealand *Siphonariidæ*," by Prof. F. W. Hutton. (*Transactions*, p. 141.)

Sixth Meeting. *6th July*, 1882.

Prof. F. W. Hutton, Vice-President, in the chair.

New Member—Stanley Edwards.

"On some Points of Difference between the English Crayfish (*Astacus fluviatilis*) and a New Zealand one (*Paranephrops setosus*)," by C. Chilton, M.A. (*Transactions*, p. 150.)

Seventh Meeting. *3rd August*, 1882.

R. W. Fereday, Vice-President, in the chair.

1. "Notes on some *Branchiate Gastropoda*," by Prof. F. W. Hutton. (*Transactions*, p. 118.)

2. Prof. F. W. Hutton exhibited specimens from the Weka Pass Rock Paintings, by means of the microscope, for the purpose of showing the presence of stalagmite.

Eighth Meeting. *7th September*, 1882.

Professor J. von Haast, President, in the chair.

New Members.—P. Westenra, A. Durand, A. Appleby.

1. "Further Additions to our Knowledge of the New Zealand *Crustacea*," by C. Chilton, M.A. (*Transactions*, p. 69.)

2. "Notes on the Structure of *Struthiolaria papulosa*, by Professor F. W. Hutton. (*Transactions*, p. 117.)

3. "Descriptions of some new Tertiary Shells from Wanganui," by Professor F. W. Hutton. (*Transactions*, p. 410.)

4. "Descriptions of New Zealand *Micro-Lepidoptera*," by E. Meyrick, B.A. (*Transactions*, p. 33.)

NINTH MEETING. *5th October*, 1882.

Professor J. von Haast, President, in the chair.

New Member.—Dr. W. H. Gaze.

1. "Notes on and a new Species of Subterranean *Crustacea*," by C. Chilton, M.A. (*Transactions*, p. 87.)

2. "On the New Zealand *Desmidieæ*, Additions to Catalogue and Notes on various Species," by W. M. Maskell. (*Transactions*, p. 237.)

3. "Further Notes on the Rock Shelter of Weka Pass," by Professor J. von Haast.

TENTH MEETING. *19th October*, 1882.

Professor J. von Haast, President, in the chair.

New Member.—W. Watt.

1. According to notice, the discussion on Professor J. von Haast's paper on the Rock Shelter at Weka Pass was resumed, and was taken part in by Professors J. von Haast, Hutton, Haslam, and Cook, and Messrs. Fereday, Inglis, and Maskell.

2. "Descriptions of new Land Shells," by Professor F. W. Hutton. (*Transactions*, p. 134.)

ANNUAL MEETING. *2nd November*, 1882.

Professor J. von Haast, President, in the chair.

ABSTRACT OF ANNUAL REPORT.

One special and nine ordinary meetings have been held, at which 18 papers have been read contributed by seven authors, viz.,—13 on Zoology, 2 on Geology, 2 on Botany, and 1 of a miscellaneous character.

Nine new members have been added to the list during the year, and 13 have withdrawn, making the number at present on the books 164.

The Council is pleased to state that valuable additions have been made to the library during the year. The donations comprise 18 volumes and about 220 pamphlets.

The additions made to the library by purchase number 128 volumes, including a valuable and complete series of the Annals and Magazine of Natural History, and also Emelin's Handbook of Chemistry.

The Council deemed it advisable in the early part of the session, to appoint a committee to revise the Rules of the Institute, and the changes were adopted at a special meeting of the Institute held 9th February, 1882.

The Council has corresponded with the other affiliated societies of the New Zealand Institute, asking if they would co-operate in suggesting to the Board of Governors the desirability of publishing the Transactions either quarterly or half-yearly. The majority of replies were favourable, but as the societies were not unanimous, the Council did not consider it advisable to proceed with the matter.

The report of the Microscopical Section stated that meetings had been held twice a month during the session, and that several of the members were actively engaged in original work.

The Hon. W. Rolleston has been chosen by the Council to vote at the election of the Board of Governors of the New Zealand Institute.

The Council had nominated for election an honorary member of the New Zealand Institute.

The balance-sheet shows total receipts for the year £197 19s. 2d.; expenditure £168 5s. 11d.; and balance £29 13s. 3d. Among the items of expenditure are £2 5s. to the Arundel Society, and £121 10s. 11d. for books.

Election of Officers for 1883:—*President*—Professor F. W. Hutton; *Vice-Presidents*—R. W. Fereday, E. Dobson; *Treasurer*, W. M. Maskell; *Secretary*—Geo. Gray; *Council*—Professor J. von Haast, Dr. Symes, C. Chilton, T. Crook, J. Inglis, T. S. Lambert.

The retiring President, Professor J. von Haast, delivered an address on the Early History of the Canterbury Philosophical Institute.

OTAGO INSTITUTE.

First Meeting. *28th March*, 1882.

G. M. Thomson, Vice-President, in the chair.

New Members.—James Hendry, B.A., Robert Jones, Wm. A. Dixon.

The meeting resolved itself into a conversazione, at which the following objects were exhibited :—

Single and Compound Microscopes—Messrs. Thomson, Gillies, and Chapman.

Collection of New Zealand *Lepidoptera*—Mr. P. Fulton.

„ „ „ „ *Coleoptera*—Mr. S. Fulton.

„ „ Australian Graptolites—Mr. F. Chapman.

„ „ New Zealand Fossil Plants—Mr. Montgomery, jun.

Preparations and Casts illustrating Human Anatomy, including Brains prepared by Giacomini's glycerine process—Prof. Scott.

Collection of *Invertebrata* in alcohol (from Zool. Station, Naples), Casts of Fossils, and other specimens recently added to the Museum—Prof. Parker.

Second Meeting. *9th May*, 1882.

W. Arthur, C.E., President, in the chair.

New Member.—Captain R. A. E. Scott, R.N.

1. "On Macquarie Island," by Prof. Scott. (*Transactions*, p. 484.)

2. "On the New Zealand *Copepoda*," by G. M. Thomson. (*Transactions*, p. 93.)

3. "On the Connection between the Air-bladder and the Organ of Hearing in the Red Cod," by Prof. Parker. (*Transactions*, p. 234.)

Third Meeting. *15th August*, 1882.

W. Arthur, President, in the chair.

New Members—Edward Milland, David Cosgrove.

1. "Notes on the New Zealand Sprat," by W. Arthur. (*Transactions*, p. 203.)

2. "On the Diseased Trout of Lake Wakatipu," by W. Arthur. (*Transactions*, p. 198.)

3. "Notes on the Anatomy and Embryology of *Scymnus lichia*," by Prof. Parker. (*Transactions*, p. 222.)

4. The Secretary exhibited the skeleton of a cow and other specimens lately added to the Museum.

Fourth Meeting. 31*st October*, 1882.

W. Arthur, President, in the chair.

1. Mr. J. McKerrow, Wellington, was nominated to vote in the election of Governors of the New Zealand Institute.

2. An Honorary Member of the New Zealand Institute was nominated for election in accordance with the Act.

3. "On the New Zealand *Copepoda*," by G. M. Thomson. (*Transactions*, p. 93.)

4. "Descriptions of some new *Crustacea*," by G. M. Thomson. (*Transactions*, p. 93.)

5. "On the Gravid Uterus of *Mustelus antarcticus*," by Prof. Parker. (*Transactions*, p. 219.)

6. The Secretary exhibited the disarticulated skeleton of a turtle having the cartilaginous parts preserved by the glycerine jelly process, and an injected preparation of the heart and gills of the skate, in alcohol, both recent additions to the Museum.

Annual Meeting. 30*th January*, 1883.

W. Arthur, President, in the chair.

1. "Notes on the Picton Herring," by W. Arthur. (*Transactions*, p. 208.)

2. "Description of a Variety of *Celmisia sessiliflora*," by D. Petrie. (*Transactions*, p. 359.)

3. "Description of two new Species of *Carex*," by D. Petrie. (*Transactions*, p. 358.)

4. The Secretary called the attention of the meeting to the circular of the "Balfour Memorial" which he had recently received from Cambridge.

Abstract of Annual Report.

During the present session five general meetings have been held, including the present annual meeting. At these meetings twelve original papers have been read, of which nine were zoological and two botanical, while one dealt with the natural features, fauna and flora of Macquarie Island.

At the beginning of this session the Council adopted a scheme for the delivery of regular courses of popular lectures. Two such courses have been given:—one, of three lectures on "Fermentation and Putrefaction," by the Secretary; and one, of four lectures on "English Literature," consisting of two lectures by Professor Mainwaring Brown on "Chaucer," and two by Mr. Alex. Wilson, M.A., on "Tennyson." In each case the plan was adopted of distributing among the audience a printed syllabus of the lectures; and a small fee, which was charged to non-members, sufficed to cover expenses of printing and advertizing. The success attending these lectures has been such as to warrant the Council recommending their continuance next session.

Six new members have joined the Institute during the session, but on the other hand the names of several defaulters have been struck off the roll. The total number of members is now 177.

The receipts of the year, including a balance of £15 18s. 3d. from last year, amount to £195 2s. 3d. The total expenditure is £167 8s. 3d., so that there remains a balance in hand of £27 6s.

The President delivered the Annual Address.

ELECTION OF OFFICERS FOR 1883:—*President*—A. Montgomery; *Vice-Presidents*—W. Arthur, C.E., Rev. Dr. Roseby; *Hon. Secretary*—Professor Parker; *Hon. Treasurer*—D. Petrie, M.A.; *Auditor*—D. Brent; *Council*—Dr. Hocken, Professor Scott, G. M. Thomson, F. Chapman, R. Gillies, G. Joachim, Professor Mainwaring Brown.

WESTLAND INSTITUTE.

ANNUAL MEETING. *13th December*, 1882.

J. Giles, President, in the chair.

ABSTRACT OF ANNUAL REPORT.

This is the Sixteenth Annual Report of the Institute. Its financial position is considered satisfactory, there being a credit balance of £20 14s. 5d.

The number of members on the roll is 90, showing an increase of 10 on the roll for 1881.

During the year there have been twelve committee meetings called and one special meeting.

A meeting of the Institute was held on the 2nd of March, when a paper was read by Dr. Bakewell "On some Difficulties of Darwinism," there was also one read by the same gentleman "On the Fallacies of Evolution," being a continuation of his former paper.

One hundred and ninety-one new books have been added to the library, which makes 2,276 volumes in the library at present.

The visitors to the Public Reading Room have been considerably more numerous than in the previous year, owing chiefly to the large influx of miners to the new rush at Rimu; and your committee intends applying to the Harbour Board and Borough and County Councils for subsidies to supplement the funds of the Institute.

The committee has much pleasure in acknowledging donations to the Library and Museum and in thanking the donors.

ELECTION OF OFFICERS FOR 1883:—*President*—W. A. Spence; *Vice-President*—T. O. W. Croft; *Hon. Treasurer*—J. P. Will; *Secretary*—Richard Hilldrup.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

Annual General Meeting. *6th February*, 1882.

The Right Rev. the Bishop of Waiapu, President, in the chair.

Election of Officers for 1882 :—*President*—The Right Rev. the Bishop of Waiapu ; *Vice-President*—Dr. Spencer ; *Honorary Secretary and Treasurer*—Mr. Colenso ; *Council*—Messrs. H. Baker, H. R. Holder, J. G. Kinross, F. J. de Lisle, F. W. C. Sturm, C. H. Weber ; *Auditor*—T. K. Newton.

ABSTRACT OF ANNUAL REPORT.

During the past winter session six ordinary meetings were held, at which nine papers prepared by members were read.

The number of members is 107, being an increase of 22 on the number of the previous year.

Throughout the year several zoological, botanical, palæontological, and geological specimens were collected by a few of the members of the Institute for the Museum.

The audited statement of accounts shows a balance of £271 15s. 7d. remaining to the credit of the society.

First Meeting. *8th May*, 1882.

Dr. Spencer, Vice-President, in the chair.

1. The Chairman gave an address on the opening of the winter session.

2. "On the large Number of Species of Ferns noticed in a small Area in the New Zealand Forests, in the 'Seventy-Mile Bush,' between Norsewood and Danneverke, in the Provincial District of Hawke's Bay," by W. Colenso, F.L.S. (*Transactions*, p. 311.)

This paper was illustrated with several botanical specimens.

3. The Hon. Secretary gave a brief address to the memory of Dr. Darwin, lately deceased, as a great and useful man. Mr. Colenso had made his acquaintance in 1835, while residing at the Bay of Islands, when Capt. (afterwards Admiral) Fitzroy and Dr. Darwin were in that harbour together in H.M.S. "Beagle," on their voyage home to England from surveying in the Straits of Magellan.

The address was supported by fitting remarks from some of the members present.

4. Some fine specimens of rare and curious insects, of the orders *Neuroptera* and *Orthoptera*, in their various stages of transformation, were also exhibited by the Hon. Secretary.

Second Meeting. *12th June*, 1882.

Dr. Spencer, Vice-President, in the chair.

1. "A Description of four New Zealand Ferns believed to be new to Science," by W. Colenso, F.L.S. (*Transactions*, p. 304.)

Specimens of the same in their various stages, together with those of some other plants, were also shown; and specimens of all the ferns were reserved for the Colonial Museum.

2. "On the hackneyed Quotation of 'Macaulay's New Zealander,'" by W. Colenso, F.L.S.

3. A fine and extensive suite of nicely preserved specimens of British and European *Sphagna* (more than 100 in number), lately received from Mr. Wm. Curnow, of Penzance, England, were also shown; and some highly curious teeth and fragments of bones (not fossil) of some small unknown Mammal, found by Mr. Balfour at Glenross, Hawke's Bay, were exhibited. These teeth, with their finely cut surfaces of numerous sharp points, excited great interest; they seemed to have belonged to some insectivorous animal. The whole lot was sent to Wellington, to Dr. Hector, for critical examination.

Third Meeting, 10*th July*, 1882.

The Right Rev. the Bishop of Waiapu, President, in the chair.

New Members.—Dr. Caro, Rev. A. D. Mulvihill, Wm. Bogle, L. Lessong, F. Reader.

1. "On Nomenclature," part i., by W. Colenso, F.L.S.

1. Mr. Hamilton exhibited a collection of Sponges of various kinds and sizes, all from Hawke's Bay, with explanatory remarks on the nature, varieties, and growth of sponges.

Fourth Meeting. 14*th August*, 1882.

The Right Rev. the Bishop of Waiapu, President, in the chair.

New Members.—Wm. Balfour, J. J. Drennan.

1. "Historical Traditions of the Taupo and East Coast Tribes, by S. Locke. (*Transactions*, p. 433.)

2. Mr. Colenso called the attention of the members to Mr. Montagu Lubbock's able paper "On the Development of the Colour Sense" (in the "Fortnightly Review" for April, 1882), as fully bearing out what he (Mr. Colenso) had last year brought before them in his paper "On the Colour Sense of the Ancient Maoris," and published in this year's vol. (xiv.) of the "Transactions N.Z. Institute." He also read several extracts from Mr. Lubbock's paper in confirmation.

Fifth Meeting. 11*th September*, 1882.

The Right Rev. the Bishop of Waiapu, President, in the chair.

1. "On some newly-discovered New Zealand *Arachnids*," by W. Colenso, F.L.S. (*Transactions*, p. 165.)

This paper was illustrated by specimens.

2. "On Nomenclature," part ii., by W. Colenso, F.L.S.

3. Fossil specimens of marine shells were exhibited, found by Mr. John Stewart in the neighbourhood of Takapau, county of Waipawa.

Sixth Meeting. *9th October*, 1882.

Dr. Spencer, Vice-President, in the chair.

New Members.—Messrs. E. B. Bendall, H. J. Gilberd, W. Scott.

1. "Maori Legends and Traditions respecting the Inhabitants of the East Coast and Hawke's Bay," (in continuation), by S. Locke. (*Transactions*, p. 445.)

2. "Notes on Freshwater *Algæ* from the District of Hawke's Bay," by W. I. Spencer, M.R.C.S. (*Transactions*, p. 302.)

3. "Descriptions of a few new Indigenous Plants," by W. Colenso, F.L.S. (*Transactions*, p. 320.)

Specimens of the several plants were exhibited.

Council Meeting. *1st November*, 1882.

The Right Rev. the Bishop of Waiapu, President, in the chair.

1. Dr. Spencer, the Vice-President, was elected to vote in the election of the Board of Governors for the ensuing year, in accordance with clause 7 of the N.Z. Institute Act.

2. Nomination was made for election of an honorary member of the N.Z. Institute, to fill up one of the late vacancies in the list caused by the deaths of some honorary members.

Annual Meeting. *6th February*, 1883.

Abstract of Annual Report

During the past session six ordinary meetings have been held. Ten papers were read at those meetings, viz.:—One on Zoology, four on Botany, and five on miscellaneous subjects.

Besides those written papers there were also some suitable addresses and lectures given—by the Vice-President at the opening of the winter session, by the Hon. Secretary to the memory of Dr. Darwin, and "On the Development of the Colour Sense," and by Mr. Hamilton, with reference to a collection of Sponges exhibited by him.

During the year seven meetings of the Council were held—for the election of new members; the selecting and ordering of books from England for the Library; the obtaining a lease for a term of years of a spacious room in the Athenæum from the trustees of the same; and for the general advancement and benefit of the Society.

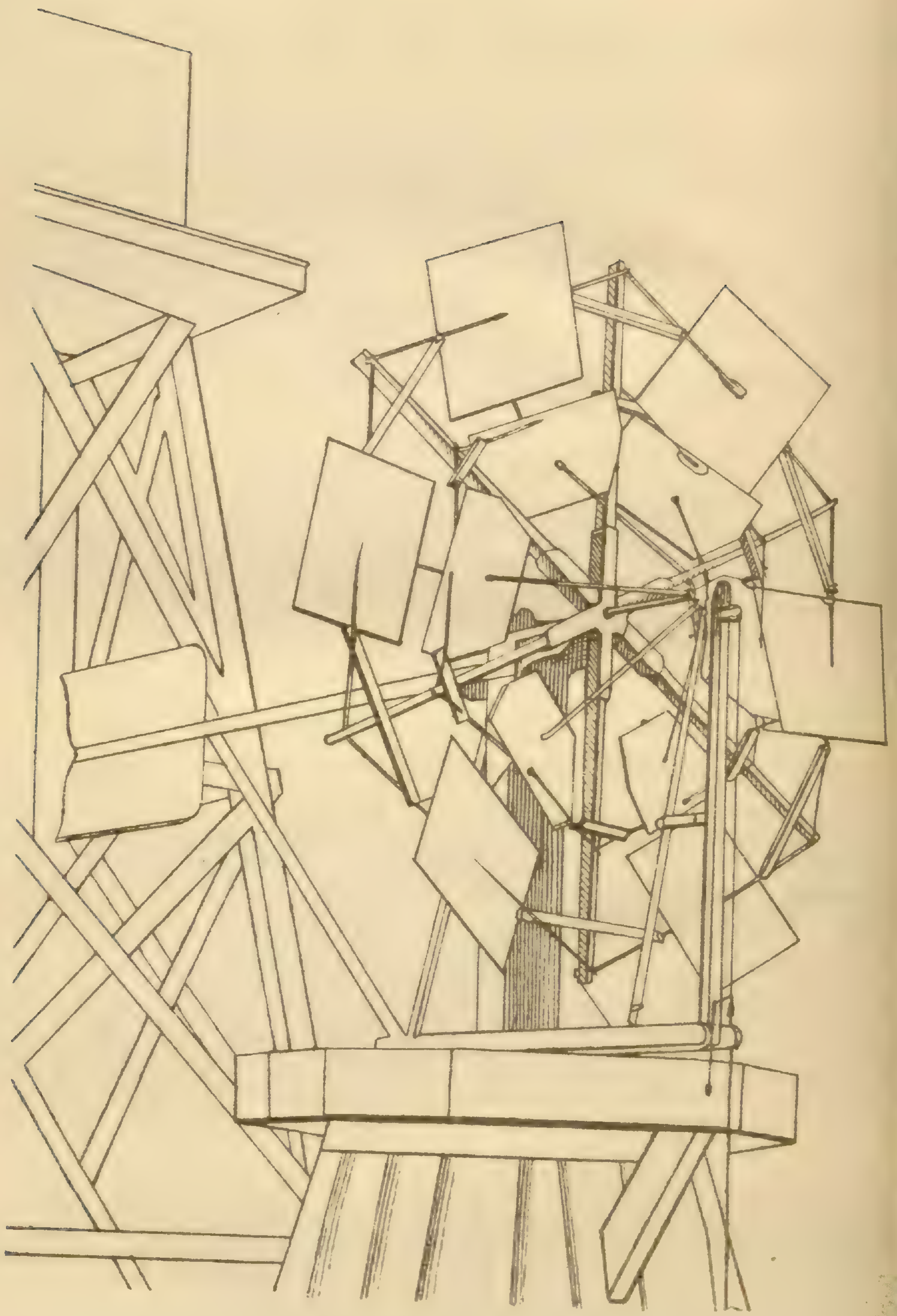
There is a total of 108 members now on the roll, two members having died during the year, and eleven new members having been elected.

The valuable scientific works, ordered from England in the early part of the year, amounting to nearly seventy volumes, have been received.

In addition to the standard works in the Library, the Council have agreed to order both from England and from Australia several scientific serials—as "Nature," "The Popular Science Observer," "Knowledge," and "The Natural History of Victoria (Zoology)."

The statement of accounts shows a credit balance of £215; the total expenditure for the year having been £180 4s. 0d., of which no less a sum than £81 11s. 10d. was expended on books and £75 in hire of premises.

Election of Officers for 1883:—*President*—The Right Rev. the Bishop of Waiapu; *Vice-President*—W. I. Spencer (Mayor); *Hon. Secretary and Treasurer*—W. Colenso; *Council*—T. W. Balfour, J. N. Bowerman, H. R. Holder, T. K. Newton, F. W. C. Sturm, C. H. Weber; *Auditor*—T. K. Newton.



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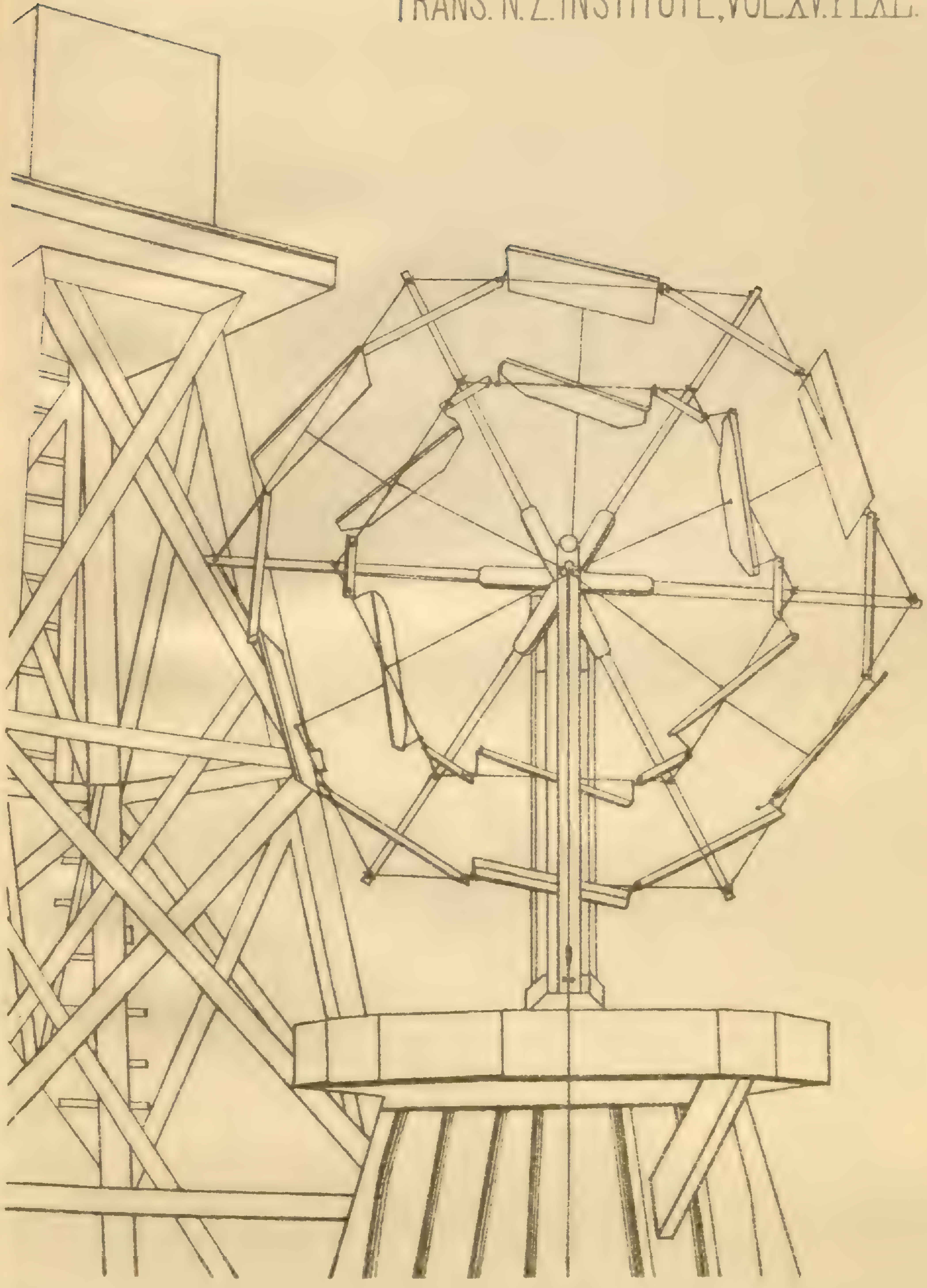

OFF SAIL.

SELF-REGULATING WIND MILL.

To illustrate Paper by J. T. Thomson, C.E., F.R.G.S.

J.B. del. from a Photo—

SOUTHLAND INSTITUTE.

First Meeting. *9th May*, 1882.

J. T. Thomson, F.R.G.S., President, in the chair.

New Members.—H. Feldwick, M.H.R., T. B. Bennett, H. Wild, Rev. J. Hobbs, C. Gilbertson.

1. The President delivered an address on the work done by the New Zealand Institute.

2. "On the Formation of the Quartz Pebbles of the Southland Plains," by W. S. Hamilton. (*Transactions*, p. 414.)

Second Meeting. *13th June*, 1882.

J. T. Thomson, F.R.G.S., President, in the chair.

New Members.—D. W. McArthur, J. Hain.

1. "On the Importance of Forestry," by D. McArthur. (*Transactions*, p. 461.)

2. "A Chapter on Folk Lore," by J. G. S. Smith.

Third Meeting. *11th July*, 1882.

T. Denniston in the chair.

1. "On Self-registering Windmills," by J. T. Thomson. (Plate XL.)

ABSTRACT.

The author gives an account of the various contrivances that have been adopted for obtaining a self-regulating Windmill, and describes in minute detail the experimental steps by which he was led to the invention of the particular form of windmill which he recommends; the leading features of which can be most easily understood from the accompanying illustration.

Fourth Meeting. *8th August*, 1882.

H. Carswell in the chair.

1. "The Use of the Training Walls in deepening Invercargill Harbour," by J. T. Thomson.

Fifth Meeting. *12th September*, 1882.

J. T. Thomson, F.R.G.S., President, in the chair.

New Members.—John Gammell, Chas. McLean.

1. "The Surface Features of the Earth and Local Variations in the Force of Gravity," by T. B. Wakelin. (*Transactions*, p. 463.)

Sixth Meeting. *10th October*, 1882.

J. T. Thomson, F.R.G.S., President, in the chair.

1. "On the Constitution of Comets," by the Rev. P. W. Fairclough. (*Transactions*, p. 477.)

Annual Meeting. *30th January*, 1883.

ABSTRACT OF ANNUAL REPORT.

During the year six general meetings were held, at which eight papers were read.

Nine new members joined the Institute during the year, the total now being sixty-two. Application was made to the Government for the granting of a site for the erection of a building suitable for the Institute, and providing room for a Museum, etc., but a definite reply was deferred pending the settlement of the question as to requirements for the railway station and extensions.

A number of valuable works have been added to the library, and a case containing a large number of mineralogical and geological specimens purchased in England has also been received. The books of the Institute are now available for reference by arrangement with the Council of the Law Society.

The receipts for the year, not including a balance from last year of £52 9s. 11d., amount to £50 8s., and the expenditure to £58 9s. 8d., including £37 7s. 9d. spent on books and periodicals, and £10 on specimens, leaving a balance in hand of £44 8s. 3d., out of which will have to come the annual outlay on books, etc.

Two vacancies which occurred during the year in the Council, by the resignation of Mr. Goyen and Dr. Galbraith, were filled by the election of the Rev. P. W. Fairclough and Mr. Carswell, and the duties of the Secretary were undertaken by the Treasurer.

It is with regret that we have to record the loss to the Society of two active members, Mr. Goyen and the late Mr. Cuthbertson, both among its originators.

In addition to the papers read at the ordinary meetings, Mr. J. T. Thomson read a paper on "Capital and Labour" under the auspices of the Institute.

Election of Officers for 1883:—*President*—J. T. Thomson, C.E., F.R.G.S. *Vice-President*—Rev. P. W. Fairclough; *Secretary and Treasurer*—J. C. Thomson; *Council*—Dr. Galbraith, Messrs. Carswell, Denniston, Hamilton, Robertson, Scandrett.

APPENDIX

Comparative Abstract for 1882 and previous Years.

STATIONS.	Barometer. At 9.30 a.m.		Temperature from Self-registering Instruments read in Morning for Twenty-four Hours previously.					Computed from Observations.		Rain.		Wind.		Cloud.
	Mean Reading.	Extreme Range.	Mean Temp. in Shade.	Mean Daily Range of Temp.	Extreme Range of Temp.	Max. Temp. in Sun's Rays.	Min. Temp. on Grass.	Mean Elastic Force of Vapour.	Mean Degree of Moisture (Saturation=100).	Total Fall in inches.	No. of Days on which Rain fell.	Average Daily Force in Miles for Year.	Maximum Velocity in Miles in any 24 Hours, and Date.	Mean Amount (0 to 10).
Auckland	29·965	1·408	59·3	13·1	44·4	135·5	31·0	·389	76	45·630	191	292	716—19 Oct.	6·6
Previous 18 years	29·954	—	59·4	—	—	—	—	·404	76	43·179	188	—	—	—
Wellington	29·900	1·353	55·4	11·4	43·0	112·0	30·0	·346	77	55·685	166	190	610—22 Jan.	4·8
Previous 18 years	29·921	—	54·8	—	—	—	—	·336	72	51·790	158	—	—	—
Dunedin	30·037	1·549	50·9	13·7	54·0	153·0	20·0	·287	76	41·796	187	120	540—26 Oct.	6·1
Previous 18 years	29·833	—	50·4	—	—	—	—	·279	74	34·672	162	—	—	—

Average Temperature of Seasons, compared with those of the previous Year.

STATIONS.	Spring. September, October, November.		Summer. December, January, February.		Autumn. March, April, May.		Winter. June, July, August.	
	1881.	1882.	1881.	1882.	1881.	1882.	1881.	1882.
Auckland	58·0	56·9	65·2	65·4	61·9	61·9	53·4	52·8
Wellington	54·4	53·8	61·6	61·5	58·3	57·8	49·4	48·8
Dunedin	51·2	50·6	57·3	56·8	54·1	52·3	45·4	43·8

NOTES ON THE WEATHER DURING 1882.

JANUARY.—A wet month, with strong S.W. and N.W. winds; temperature generally lower than the average. Earthquakes at Wellington on 9th at 2.20 a.m., and on 17th at 10.45 p.m., slight.

FEBRUARY.—Fine weather except in the south, where the rain was rather in excess; occasional strong winds from N.W. and S.W., and at times thunder. Earthquakes: At Wellington, on 1st at 2.20 p.m., slight, and at 3.8 p.m., sharp; on 20th, very slight, about midnight; on 21st at 6.30 a.m., slight. At Lincoln, on 1st, slight, at 3.5 p.m.

MARCH.—Wet close weather prevailed; wind moderate, and chiefly N.E. Earthquake at Lincoln on 22nd at 9.10 a.m., slight.

APRIL.—Generally showery month, but with moderate and variable winds. Earthquakes felt at Wellington on 6th at 4.10 p.m., sharp, and at 4.19 p.m., slight; on 16th at 7.30 p.m. and 11 p.m., slight: at Lincoln on 6th at 3.45 p.m. Brilliant aurora observed on 16th, 17th, 18th, and 20th.

MAY.—On the whole a wet month and squally, with variable winds. Earthquakes at Wellington on 14th at 5.10 p.m., and 15th at 12.20 and 4.15 a.m., all slight.

JUNE.—Rain rather in excess of usual average, and some unpleasant squally weather experienced, especially in earlier part. Earthquakes felt at Wellington on 6th at 8 p.m., and 11th at 7 a.m., slight.

JULY.—A very wet unpleasant month, with strong S.W. and W. winds, very low pressure. Earthquakes occurred at Wellington on 24th at midnight, slight, and on 25th, early morning, slight.

AUGUST.—Fine generally in north and south, but at Central Station much rain and stormy weather prevailed.

SEPTEMBER.—Stormy and wet weather with heavy showers, though total rain not excessive in the north; frequent thunder and hail and N.W. and S.W. winds; generally fine at southern stations. Great comet first observed on 7th.

OCTOBER.—Generally showery weather, but no heavy falls of rain; winds westerly. Earthquake at Wellington on 20th at 12.19 a.m., slight. Brilliant meteors observed on 29th and 30th.

NOVEMBER.—On the whole fine, with moderate rainfall and variable winds. Earthquakes felt at Wellington on 18th at 11.4 p.m., slight, and on 25th at 10.50 p.m., smart. Auroras between 17th and 20th, and meteor on 29th.

DECEMBER.—Fine, with little rain and moderate winds prevailing from N.W. in the north, but wet dull weather with light winds in the south.

Earthquakes reported in New Zealand during 1882.

Place.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Tauranga ..	..	1*	..	..	..	..	..	..	..	..	..	..	1
Gisborne ..	..	1*	..	..	..	..	..	..	..	25	..	..	2
Napier ..	..	1*	24	..	..	..	..	..	..	25*	..	..	3
Hawera ..	..	1*	..	6†	..	..	..	..	..	..	..	..	2
Opunake ..	..	..	..	6†	..	..	..	..	..	..	..	..	1
Patea ..	..	..	..	..	..	..	24*	..	..	..	..	..	1
Marton ..	..	1*	..	..	..	..	..	..	..	..	..	..	1
Carterton ..	..	1*	..	..	..	..	..	..	..	20*	..	..	2
Wanganui	..	..	..	6†	..	..	24*, 26*	..	..	..	..	..	3
Wellington	9, 17	1*, 20, 21	..	6*, 16	14, 15	6, 11	24, 25	..	..	20	18, 25*	..	16
Normanby ..	..	..	..	6*	..	..	..	..	..	..	..	..	1
Nelson ..	..	1*	..	6*	..	..	..	..	..	..	..	..	2
Blenheim ..	..	..	..	6*	15	..	..	..	..	..	..	..	2
Christchurch	7, 10	1*	22	6*	..	..	..	..	..	..	..	..	5
Ashburton ..	..	1	..	..	..	..	..	..	..	..	..	..	1
Lincoln ..	..	1	22	6	..	..	..	..	..	..	..	..	3
Hokitika ..	..	1	..	..	..	..	..	..	..	..	..	..	1
Oamaru ..	..	..	..	..	..	..	15	..	..	..	..	..	1
Kumara ..	..	..	..	..	..	..	20*	..	..	..	..	..	1
Seafield ..	..	..	..	..	..	..	..	31*	..	..	..	..	1
Rangiora ..	..	..	..	..	..	..	..	20	..	..	..	..	1
Springfield	..	..	..	..	..	..	..	..	25	..	..	..	1
Dunedin ..	..	..	..	..	5*	..	..	..	..	20	..	..	2
Greymouth	..	1*	..	..	..	..	..	..	..	..	..	..	1
Queenstown	..	..	..	4*	..	..	..	..	..	..	..	..	1

The figures denote the days of the month on which one or more shocks were felt. Those with an asterisk affixed were described as *smart*, those with a dagger as *severe shocks*. The remainder were only slight tremors, and no doubt escaped record at most stations, there being no instrumental means employed for their detection. These tables are therefore not reliable so far as indicating the geographical distribution of the shocks.

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